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An Undergraduate Internship Report on Network Infrastructure Design

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An Undergraduate Internship Report
on
Network Infrastructure Design

By

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Autumn, 2022

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Dissertation submitted in partial fulfillment for the degree of
Bachelor of Science in Computer Science

Department of Computer Science & Engineering
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Attestation

This serves as confirmation that I, **Farjana Nur (ID: 1821516**), finished the report titled **"Network Infrastructure Design"** and submitted it in part fulfillment of the requirement for the Degree in Computer Science and Engineering from Independent University, Bangladesh. Under the direction of my university supervisor **Md. Abu Sayed** and corporate supervisor **Md Mahbub Ul Haque Alvi**, the project coordinator at **Global Informatics Limited**, it has been finished. Because I applied what I learnt during my internship to this project and properly acknowledged it in this report. I hereby verify that all of my work and the minor details presented in the report are accurate and verifiable. If more information is needed to verify the veracity of the report, please don't hesitate to get in touch with my administrators.

24/1/2023

Signature   Date

Farjana Nur

Name

Acknowledgement

Letter of Transmittal

December 22, 2022
Md. Abu Sayed
Lecturer
Department of Computer Science and Engineering
Independent University, Bangladesh.

Subject: Internship report submission for Autumn, 2022

Dear Sir,

I am presenting the internship report for the Global Informatics Limited project titled "Network infrastructure Design" with the most pleasure which I am submitting to you as a partial completion of the CSE degree program. My best efforts have been made to research, gather information, and finish my report by the deadline. I'm writing to let you know that my internship with Global Informatics Limited is now complete, and I've got a final report ready to go. On September 17, my official internship program began, and I have since finished it.

This most recent report is based on the work I did for Global Informatics Limited while I was an intern. My internship's main goal was for me to obtain expertise in a variety of business sectors related to innovation, starting with documentation requests, content creation, planning checking, and promoting familiarity with best practices. Working here has been a very amazing experience. During my internship at Global Informatics Limited, where I learnt a lot and really put my effort into planning the report, I actually developed a lot of skills. Finally, I want to say how much I appreciate your guidance and support. I've tried to be as thorough as I can with this report, so please accept my sincere requests that it satisfy all of your requirements and meet all of your expectations.

I genuinely hope and wish that you will find the information interesting and that it will live up to your expectations. I've made every effort to prevent any mistakes, and I hope my report meets your standards.

I also want to express my gratitude for giving me the chance to submit my report.

Sincerely,
Farjana Nur
ID: 1821516
School of Computer Science and Engineering
Independent University, Bangladesh

Evaluation Committee

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Signature

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Name   *Rubayed Mehedi*

....

Internal Examiner-1 / Panel Member-1

....

Signature

Sabrina Alam

Name

Sabrina Alam

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External Examiner-2 / Panel Member-2

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Signature

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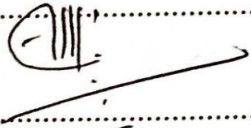
Name   *Md Abu Sayed*

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Supervisor of the intern

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Signature

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Name

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Head, Department of Computer Science & Engineering

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Abstract

Global Informatics Limited (GIL) is a strategic, most-trusted and credible service provider in the field of Technology Services & IT infrastructure Solution, Software Development and IT consulting since 2017.

In this report, I've evaluated my three month internship participation, as well as my work for Global Informatics Limited.

When I was offered the option to complete an internship at Global Informatics Limited, I got the chance to work and learn with a technical team. The project's goal for a company is to provide Structure LAN networking and I participated with the configuration and design of the project. I've included every action I made that helped me achieve my goals, some in more detail than others. I've kept track of all the skills I've developed during this time. I detailed all of my responsibilities, my progress, and my completion of the work that was assigned to me. I had to finish my learning sessions before starting the projects, and for this particular session, I had to learn about the functionality, networking topologies, and wire management of the product.

This report details the complete project about which I learned during my internship. The specialized arrangements we'll give managing an account adaptability with work prospects. Global Informatics Limited is the vital state- owned driving open commercial IT company in Bangladesh. It is one of the biggest companies within the nation.

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Chapter 1

Introduction

1.1 Overview/Background of the Work

I started my internship program at Global Informatics Limited in the department of networking section on 17th September 2022. Networks are typically more susceptible to viruses because of technical shortcomings. Both had current software created to mitigate these risks, and high-quality routing systems and hardware is essential. Setting up a computer network in a business setting is very different from doing so at home or in a domestic environment. The design of a business network needs to be revised with complexity and security issues. The network might be established, constructed, installed, maintained, and configured to achieve particular commercial and technical goals.

A business network comprises physical and virtual networks and protocols to connect all users and systems on a local area network (LAN) to data centers and cloud applications and enable access to network data. In the meantime, I learn router configuration, switch configuration, LAN, WAN, cabling, maintenance, reporting, etc.

My project (Network Infrastructure Design): A network design and system that provides access to network data and analytics connects all users and structures on a local area network (LAN) using physical and virtual networks and protocols. The basis of a corporation is its network infrastructure, which must serve all applications, databases, and operational goals, both present and future. It must also be accessible and adaptive. The Network Infrastructure is comparable to the Internet. However, it is only available within the boundaries of one specific organization. The network will be designed using the **Microsoft Visio** and **Cisco Packet Trace**r for configuration, emphasizing making the backbone system user-friendly and offering constant network access for the organization's workforce.

1.2 Objectives

Each firm needs its own networking solution for the demands of production, customer, logistics, management, and other job tasks. Organizations can benefit significantly from the right network design, which some they are listed below:

- Resource sharing is the computer network's primary goal. The goal is to provide all network users access to all software, data, and hardware.
- The second goal is to offer excellent reliability.
- Businesses can connect to apps and data that are managed and protected by local firewalls deployed internally and externally, ensuring the security of the data.

1.3 Scopes

This Infrastructure design-based real-time solution for structure LAN managing systems is a great help for people using this internet world. This design has four different types of components: router, switch, server and pc as a user and the configuration is also connected with users. Users can send and receive data in the server via router and switch in a specific way. For login, Mac bind configuration is used, so that is very high security maintained. This design is very effective for users, and they can use it for their needs and safety.

Chapter 2

Literature Review

2.1   Relationship with Undergraduate Studies

I have learned courses about Networking in my undergraduate studies. Those courses are related to my internship project. So the relationship with my undergraduate courses is given below:

CSE316 (Data Communication and Computer Network):

Basic concepts, network categories, network topologies, the OSI model and TCP/IP protocol suite, TCP/IP applications, FTP, SMTP, HTTP, and WWW, transport layer protocols, Internetworking devices, repeaters, bridges, and routers, routing algorithms, IP addressing, subnetting, and domain name systems are all covered in this course. Client-Server programming, socket programming, data link control protocols, LAN types and technology, MAC protocols, high-speed LANs and Gigabit Ethernet, Wireless LANs, MAN, Circuit switching and Packet switching, ISDN, Frame interfaces and modems, transmission media, fibre optic and wireless media, error detection techniques are all examples of network programming.

CSE400 (Data Communication):

Data communication networks are concerned with the transfer of data between two places. Data begins from the source and is eventually sent to the destination, also known as a sink. It can also be categorized based on the media the signal travels through. In this scenario, there are two sorts of transmissions: guided transmission and wireless transmission; wireless transmission is also known as unguided transmission. Two methods for transferring data from source to destination are switching and broadcasting. Data is transmitted from source to destination in a switched network via a succession of intermediate switching nodes. All network nodes in a broadcast network receive a transmission from a source.

CSE406 (Cryptography and Network Security):

Basics of Security and Cryptography, Trust and Security, Various Security Issues, Classical Encryption Techniques, Block Ciphers and Data Encryption Standard, Advanced Encryption Standard, Contemporary Symmetric Ciphers, Modes of Operation, Symmetric Encryption, Public Key Cryptography (PKC), Key Management and other PKCs, Hash and MAC Overview, Firewall are all covered in this course.

2.2   Related works

Although my application is similar to a few other comparable ones currently on the market, the degree of similarity could be better. In my design, I used structure LAN. The other related work is below:

- **Design and Simulation of Local Area Network Using Cisco Packet Tracer:** In this research, a Local Area Network (LAN) that combines wired and wireless architecture with some important ideas, like DHCP, DNS, email, and VLANs, has been developed using Cisco Packet Tracer. Clients on the network have been logically grouped using VLANs, and data packets are routed from one device to another with the help of router and switch configurations. Furthermore, it should be noted that the configuration and criteria are for the initial concept and that further functionality can be added to extend support and coverage.
Here is the research paper:
Design and Simulation of Local Area Network Using Cisco Packet Tracer Nathaniel S. Tarkaa , Paul I. Iannah , Isaac T. Iber, Department of Electrical and Electronics Engineering, University of Agriculture, Makurdi, Nigeria Corresponding author: Nathaniel S. Tarkaa

- **Design, Deployment and Implementation of Local Area Network(LAN) at BAEC Head Quarter:** The most recent technology was suggested in this research paper as a secure network and system design for the Linux and Windows environments. Understanding communication models, network service & architecture, media, devices, and protocol suites is necessary. Every network needs routine maintenance, including storage upkeep, remote resource access, user administration, log management, and other management tasks. For all network systems, monitoring is a frequent duty. Following the application of our suggested design, implementation, and highly dependable local area network method. Because of this, the procedures in this article are thoroughly explored in order for the Local Area Network (LAN) system at BAEC Headquarters to function effectively as a whole.
Here is the research paper:
Design, Deployment and Implementation of Local Area Network(LAN) at BAEC Head Quarter
Osman Goni
Corresponding Author
Engineer, Computer System and Network Division (CSND), Institute of Computer Science (ICS), Bangladesh
Atomic Energy Commission, E-12/A, Agargaon, Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh

Chapter 3
Project Management & Financing

3.1 Work Breakdown Structure

A project is visually, hierarchically, and deliverable-focused deconstructed using a work breakdown structure (WBS). It is a useful diagram for project managers since it enables them to deconstruct the scope of their projects and see all the tasks necessary to finish them. The work breakdown structure chart is a crucial project planning tool because it lists every phase of a project's work. The WBS levels below the project scope represent the activities, deliverables, and work packages required to complete the project from beginning to end. The final project deliverable and the tasks and work packages connected lie on top of the WBS diagram.
A deliverable-based work breakdown structure clarifies how the project's deliverables such as its products, services, or results—are related to its scope. A Deliverable-Based WBS for constructing a Structure LAN for a business is shown
in Figure 3.1.
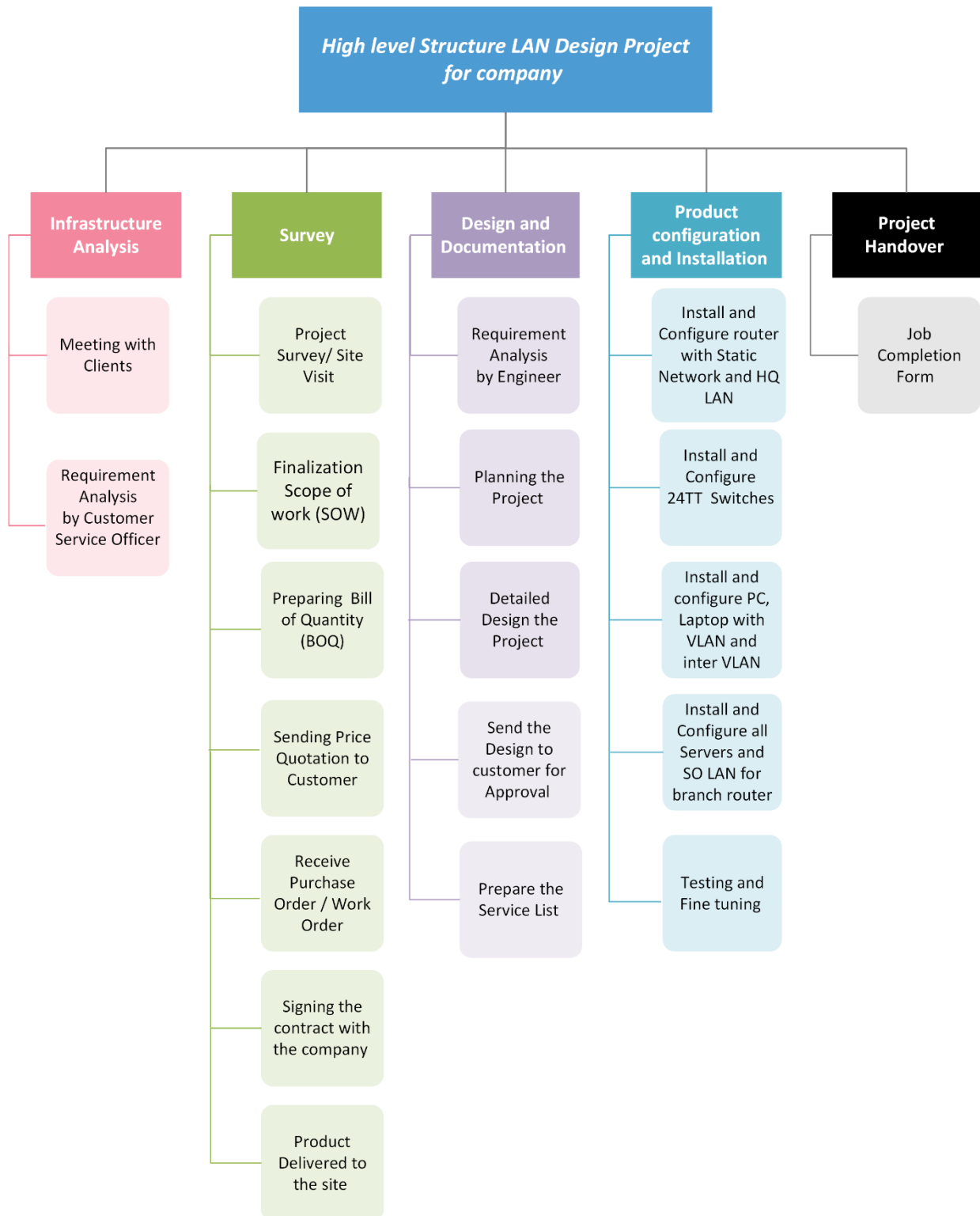
Fig 3.1 : Work Breakdown Structure of Structure LAN for a company

3.2   Process/Activity wise Time Distribution

The time required for completing each task shown in the WBS chart above is approximately represented by the following table 3.2.

Table 3.2: Time Distribution of Activity chart

Task Name	Duration	Start	Finish
Infrastructure Analysis	5 day	September 27, 2022	October 2, 2022
Survey and Product Delivery at site	30 days	October 3, 2022	November 3, 2022
Detail Design and Planning	20 days	November 4, 2022	November 24, 2022
Product Configuration and Installation	28 days	November 25, 2022	December 24, 2022
Project Handover	5 days	December 26, 2022	December 31, 2022

3.3   Gantt Chart

The project team widely uses Gantt charts. It is one of the most popular and practical methods for comparing the time given for specific tasks, events, or activities to those tasks, occurrences, or actions themselves. On the chart's left side, you can see a list of the activities and the relevant time scale.
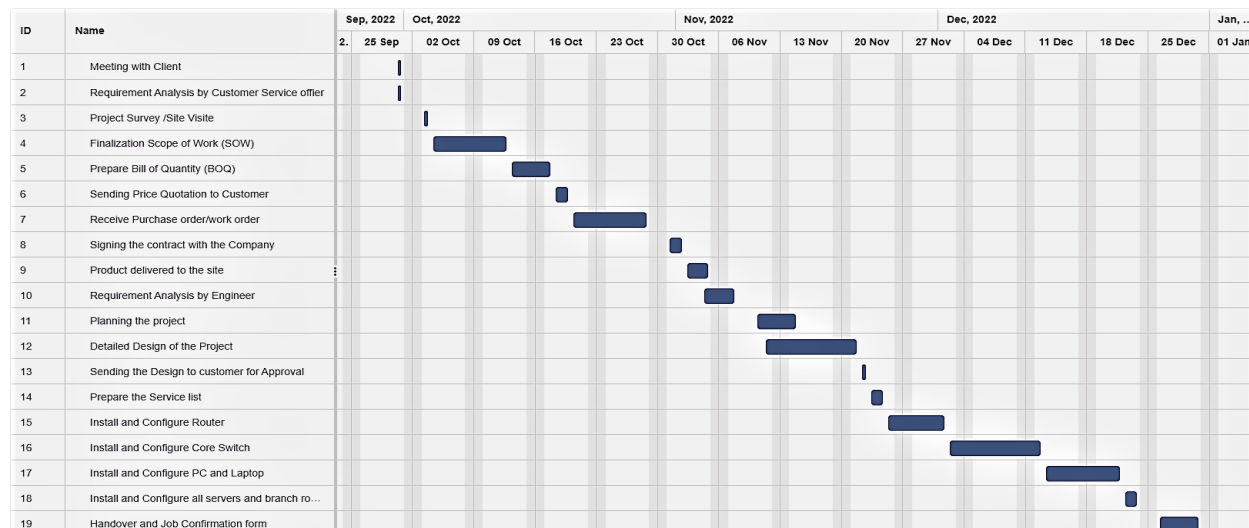
Fig 3.3: Gantt Chart for Network Infrastructure Design

3.4 Process/Activity wise Resource Allocation

Adequate network infrastructure is crucial for any organization. Since this is the case, one of the top-level management's primary responsibilities is ensuring that their business organization has the best communication channels that meet the company's needs. The organization's departments and the people who work in them are the main focus of this project. The people who work in those departments are portions of that.

Infrastructure Analysis: The project started at this stage. At this stage, the organization's IT member meets and analyzes the customer's requirements.

Survey and Product delivery at the site: This is the most crucial stage for the organization and the customer. First, the organization's IT team have to visit the work site and also they have to finalize the scope of work which we can call SOW. After completing it, we will make the product list and its quantity. Then prepare the bill of product list and send it to the customer with a price quotation. The customer receives the order of work and signs the contract. After confirming and signing this work, the survey process will be done.

Detail design and planning: In this stage, the organization's IT team and engineers set a session for analyzing customers' requirements. After attending the session, we will plan how to design the project and make a design with the requirements. We have to send the design and service list to approve the design. So the real work will be done with profound timing. That process is the most valuable part of planning or designing a project.

Product Configuration and Installation: We have to install and configure all products that can work appropriately for running products. It is the most important and significant part of a company. So firstly, we need to set up the routers, switches, PCs, and laptops with HQ LAN, SO LAN and VLAN. After configuring all products, we need to test them so that we can check whether the configurations are correct or not. After confirming the configuration, our work is ready to hand over to the customer.

Project Handover: When the customer signs the final job completion form, the project is launched live and made operational.

3.5   Estimated Costing

Here is the costing of a structure LAN in table 3.5

Table 3.5: Estimated costing of a structure LAN

Component Name	Model	Description	Quantity	Unit Price(tk)	Total Price(tk)
Firewall	Sophos	Xg 86 Enterprise protect 3 yr bundle VPN Firewall Appliance	2	135,330	270660
UTP cable	Rosenberger	Cat6	85 box	16,500	1402500
Fiber Optics	Rosenberger		235 m	220	51700
24 port Switch (Core, distribution, branch)	Cisco	Switch Cisco 24-Port Gigabit PoE+ SFP	8 pcs	65,000	52000
24 Port Patch Panel	Rosenberger		4 pcs	9,500	38000
Patch Cord	Rosenberger	Fiber Patch Cord 5M LC-LC	60 pcs	150	9000
Connector	Micronet	Cat-6, 20pcs	5 box	800	4000
Wire Manager	Rosenberger	Wire Manager in 1U.	8	2,500	20000
Modular	Rosenberger	Cat-6 Rj-45 Modular	60	350	21000
Network Cabinet	Toten	9u Rack Wall Mount Server Cabinet Glass Door 600mX9UX600m	4	11,000	44,000
UPS	Zigor Volga	NG+3 3KVA online UPS	4	35,200	140800
Router	Cisco	Router of 24 port	4	75,000	300000
Face Plate	Rosenberger	faceplate (one port and a shutter) (single port and a shutter)	60	175	10500

SFP Module	N/A	Single-mode SFP Transceiver at 1.25G	8	1500	12000
TJ Box	N/A	Indoor terminal connection for box 8	28	80	2240
Server	Dell	PowerEdge R740 32Gb/HDD	10	277,771.82	2777718.2
Local Accessories	N/A	Clamps, Screw, Royal Plugs, Flexible Pipe, PVC pipe	1	60,000 (Approx.)	60,000 (Approx.)
User (PC & Laptop)	Dell	Dell OptiPlex 3080 MT Core i5 10th gen	30	63,000	1890000
Total					7206118

Chapter 4
Methodology

As the basis for the design process for the network employed in this project, the CISCO-PPDIOO (Prepare, Plan, Design, Implement, Operate, Optimize) methodology was used. Cisco separated PPDIOO into phases to structure the task of developing and managing a network. Cisco divided PPDIOO into phases to structure the project of creating and managing a network. The PPDIOO phases are described here, along with how they relate to network design methodology.

The following are the PPDIOO phases:

Prepare: This entails identifying technologies that best support the architecture, formulating organizational needs, developing a network strategy, and proposing a high-level conceptual architecture. By evaluating the business case for the proposed architecture, the preparation phase can generate a financial basis for network strategy.

Plan: Identifying initial network requirements based on goals, facilities, and user needs, among other things. During the planning phase, locations are characterized, existing networks are assessed, and a gap analysis is performed to establish whether the existing system infrastructure, sites, and operational environment can support the proposed system. A project plan is essential for managing the tasks, responsibilities, critical milestones, and resources needed to accomplish network modifications. The scope, pricing, and resource parameters stated in the initial business requirements should be reflected in the project plan.

Design: The network design professionals' efforts are guided by the initial requirements generated during the planning phase. The network design specification is a detailed design that includes parameters to enable availability, reliability, security, scalability, and performance. The design specification serves as the foundation for all implementation tasks. As briefly outlined below, every other step influences design choices, and the Design phase is inextricably linked to all of them.
- The design is generated based on the needs discovered during the Prepare and Plan phases.
- The Install phase also includes initial testing of the design on the network.
- The Operate and Optimize stages will finally decide whether or not the design is adequate based on network analysis and any emergent concerns. If any issues are discovered, the network may need to be reconfigured.

Implement: The network is established, or more components are added following the design standards, to integrate devices without disturbing the existing network or creating vulnerabilities.

Operate: The final test of the design's appropriateness is operation. The operational phase entails preserving network health through day-to-day activities, such as ensuring high availability and lower costs. The everyday processes of defect detection, rectification, and performance monitoring provide the starting date for the optimization phase.

Optimize: Involves proactive network management. Proactive management aims to identify and handle problems before they harm the organization. When proactive management cannot forecast and mitigate failures, reactive fault detection and repair (troubleshooting) are required. The optimization phase of the PPDIOO process may necessitate a network redesign if too many network problems and mistakes occur, performance falls short of expectations, or new applications are identified to satisfy organizational and technical requirements.

Although the design is one of the six PPDIOO phases, some design components can be seen. Furthermore, utilize the six PPDIOO phases as a model or framework; they do not have to be used precisely as described.
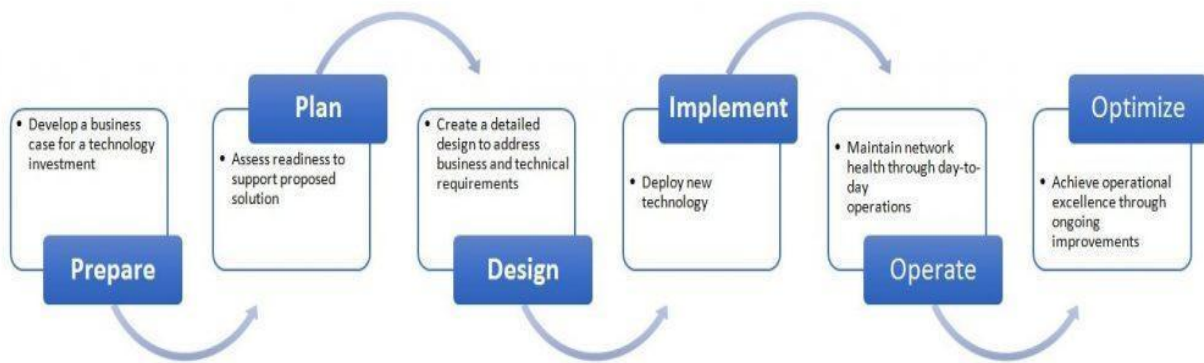

Fig 4: The Cisco PPDIOO Network Lifecycle

Chapter 5
Body of the Project

5.1   Work Description

A network design and system also provide access to network data and analytics and connect all users and structures on a local area network (LAN) using physical and virtual networks and protocols. The basis of a corporation is its network infrastructure, which must serve all applications, databases, and operational goals, both present and future. It must also be accessible and adaptive. The Network Infrastructure is comparable to the Internet. However, it is only available within the boundaries of one specific organization. The network will be designed using the **Microsoft Visio** and **Cisco Packet Tracer** for configuration, emphasizing making the backbone system user-friendly and offering constant network access for the organization's workforce. Employees from different departments and branches may access the central storage server depending on their authorisation and usage regulations. The IT management staff has complete control over the access points and endpoints. When it comes to the essential customizability of the design, the IT team will be able to add as many features as they like in the future. The goal will be to maximize server use cases while minimizing energy usage during the implementation and testing phases. The core network will be regularly maintained and watched, allowing for speedy debugging of potential problems. For the convenience of its users, the network shall be adequately maintained regularly by the network administrator and network managers.

As an intern, I was responsible for creating both the core and regional branch networks.

5.2 Requirement Analysis

Rich Picture

A thorough analysis of the situation and its identification and characterization results in the creation of a rich picture. A rich picture can aid in igniting conversation and achieving a wide-ranging, universal knowledge of a subject by utilizing photos, text boxes, symbols, and icons. Unlike software engineering, there isn't a standard methodology for building a rich picture in the networking sector. The comparison would be to a network architecture diagram instead.
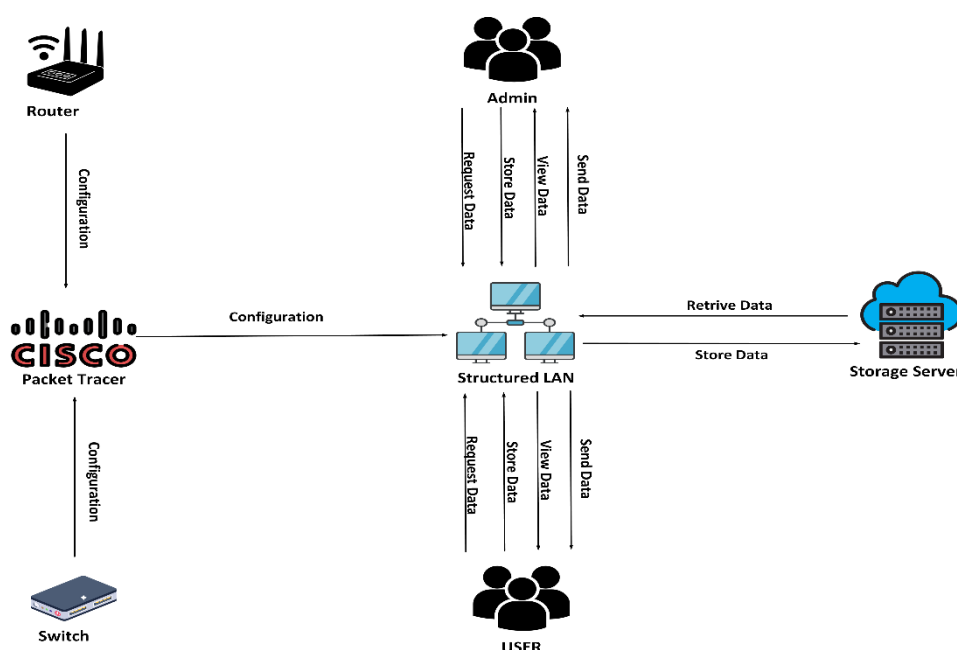
Fig 5.2: Rich Picture of network infrastructure design

Functional Requirements:

Any system design's foundation comprises functional requirements, which specify how systems and technologies should work. Functional requirements specifically define what these technologies or systems will give to the business technologically.

- Ability to create a boundary between the visitor and internal staff traffic (wired and wireless) in compliance with the organization's normal security policy.

- It supports expanding the network without modifying it to accommodate additional remote sites. The location of the central server must be outside the access layer.

- The storage server must be accessible to all associations and departments simultaneously.

- Aside from being granted restricted administrative access to the servers and network components, the IT department must be provided authentication credentials.

Non-Functional Requirements:

- The post team needs a minimum of six days after the project is finished to give it over and sign off.

- All employees must be able to accomplish their work efficiently, continuously, and with as few connectivity-related barriers as feasible.

- Like any other backbone network, this one must be able to grow in order to accommodate future expansion.

- The program needs to be stable and dependable.

5.2   System Analysis

5.2.1   Six Element Analysis

Table 5.2.1 Six element analysis

Process	Task					
	Human	**Hardware (Non-Computing)**	**Hardware (Computing)**	**Software**	**Database**	**Network Segment**
Planning Project	Admin and Intern Discuss about the project and analysis the requirements of client	1.Pen & Paper For taking notes the discussion about project's requirement	Laptop/PC For keeping a softcopy of documentation	1.Microsoft Word Using to make documentation	None	Internet Internet connected with PC
Installation	Admin Installing router, switch and cisco for configuration	1.Pen & Paper For taking notes of the installed product	Laptop/PC Used for Installing Cisco for configuration	1.Microsoft Word Using to make documentation for installed product	None	Internet Internet connected with PC
Switch and Router Configuration	Employee and intern They will configure head office and Branch office switch and router	1.Pen & Paper For taking notes of the switch and router configuration	Laptop/PC Used for configuration	Cisco For configuring Mac address, DHCP, OSPF and static network set up in router, switch port set up in switch	None	Internet Internet connected with PC

| Users IP Configuration | Employee and intern

They will configure all users IP address | 1.Pen & Paper

For taking notes of the configuration | Laptop/PC

Used for configuration | Cisco

For configuring VLAN and inter VLAN in users | None | Internet

Internet connected with PC |
|---|---|---|---|---|---|---|
| **Network testing** | Employee

Will test the network in head office and branch office | Fluke Tester

Test the network system | Laptop/PC

Used for the flow of internet | None | None | Internet

Internet connected with PC |
| **Maintenance work** | Employee

Maintain the required work | 1.Pen & Paper

to take notes for the maintenance | Laptop/PC

Used for maintenance | Microsoft Word

Using to make documentation for maintenance | None | Internet

Internet connected with PC |

5.2.2 Feasibility Analysis

The preliminary research revealed an important finding: the suggested approach works. A systematic review was carried out to find the optimal strategy for meeting the performance standards. If you want to assess the project's viability as soon as feasible, conducting a feasibility analysis is prudent and essential. It comprises performing a preliminary project analysis and figuring out whether the proposed architecture will be helpful to the business. You can spare yourself days or months of work, a sizable sum of money, and professional shame if a design problem is found early in the testing process. Technical, operational, and economic factors are combined to form three categories that describe loyalty.

- **Technical Feasibility:** It is assumed that the necessary hardware and software are both technically feasible. Before evaluating technological feasibility, we need to ascertain whether the hardware and software can adequately store the company's critical data. The infrastructure and technological capabilities of the project are evaluated as part of this technical feasibility study. A feasibility study also considers the technical expertise of the technical team, the application of current technology, the simplicity of management and the customization of the chosen technology, among other things. The viability of a particular project was considered.

- **Operational Feasibility:** It is expected that the new structure and network design would suffice for the demands of the business and satisfy operational requirements.

- **Economic Feasibility:** Any business or organization that wants to establish a robust network infrastructure must make a sizable upfront investment. But it's important to remember that no frivolous expenses are covered. Performance and cost are superbly balanced in the suggested architecture.

5.2.3　Problem Solution Analysis

This section describes the issues that were identified, looked into, and ultimately had a solution developed to address them. The problems that have been found include the following:

- **Unknown Component:** While we are working on the design, I don't know some components and cables that we need to use.

- **Communication:** As an intern, it was tough to communicate with an engineer to discuss the project.

- **Cisco configuration:** For configuration, cisco is tough to use because the codes are not changeable when it is written.

- **Not able to visit the site:** As an intern, I'm not permitted to visit the site.

The solution to that problems are given below:

- **Solution of unknown components:** For making design, first we need to know the details of all components and their uses. So we can google it for knowing the details of components.

- **Solution of communication:** To collect accurate information, I have to join the session on project-related work. Then I can manage or communicate with engineers and discuss the steps of doing work.

- **Solution of cisco configuration:** To avoid the errors, I have to write the codes correctly because, for simulation, it needs proper code; otherwise, the simulation will not be successful.

5.2.4   Effect and Constraints Analysis

An organization's level of adaptability when developing a solution is constrained. Limitations include limits that reduce production, including deadlines, operational problems, and financial constraints. A high-level policy or constrained investment resources that limit the project team's ability to create a platform throughout production. The following list includes several conditions and their outcomes.

- **Time:**

Time constraints also constrain the capacity of an organization to deliver a product. Money and time are intertwined. Financial limitations impacted the planning process. Therefore each step had to be finished as fast as possible to meet the deadline.

- **Budget:**

The budget of a firm is one of its most significant vital constraints. The pricing of various products was constantly rising due to the local market's fluctuating dollar exchange rate, which posed a considerable problem to the project budget section.

- **Location:**

Location is one of the most challenging sorts of constraints since it might impose limitations that have an indirect effect on the design. For example, a remote site could be located without fibre infrastructure, and only wireless communication is offered. This might not be a significant problem from an architectural perspective.

- **Infrastructure hardware:**

The use of old network devices is an excellent illustration. If a company doesn't have plans to replace these devices, it may be challenging to optimize the design of new features or protocols that current old platforms are unable to implement.

- **Knowledge of the staff:**

Network designers may occasionally recommend the best design using the most recent technology available, which can lower the total cost of ownership for the company. The workers of this company may have a problem with this if they lack knowledge of the technology needed to run and maintain the network.

- **Train the employees on these new technologies:**

This comes with a risk because the staff's inexperience may make it harder for them to resolve any problems that might arise, and downtime for the data center can be pretty expensive for the company.

5.3   System Design

5.3.1   UML Diagrams

UML standard has no separate kind of diagrams to describe network architecture and provides no specific elements related to the networking. Deployment diagrams could be used for this purpose usually with some extra networking stereotypes. Network architecture diagram will usually show networking nodes and communication paths between them.

Use case Diagram:

Use case diagrams are used to collect a system's requirements, taking into account both internal and external factors. Most of these needs are for the design. Therefore, use cases are created and actors are identified when a system is evaluated to gather its functionality.
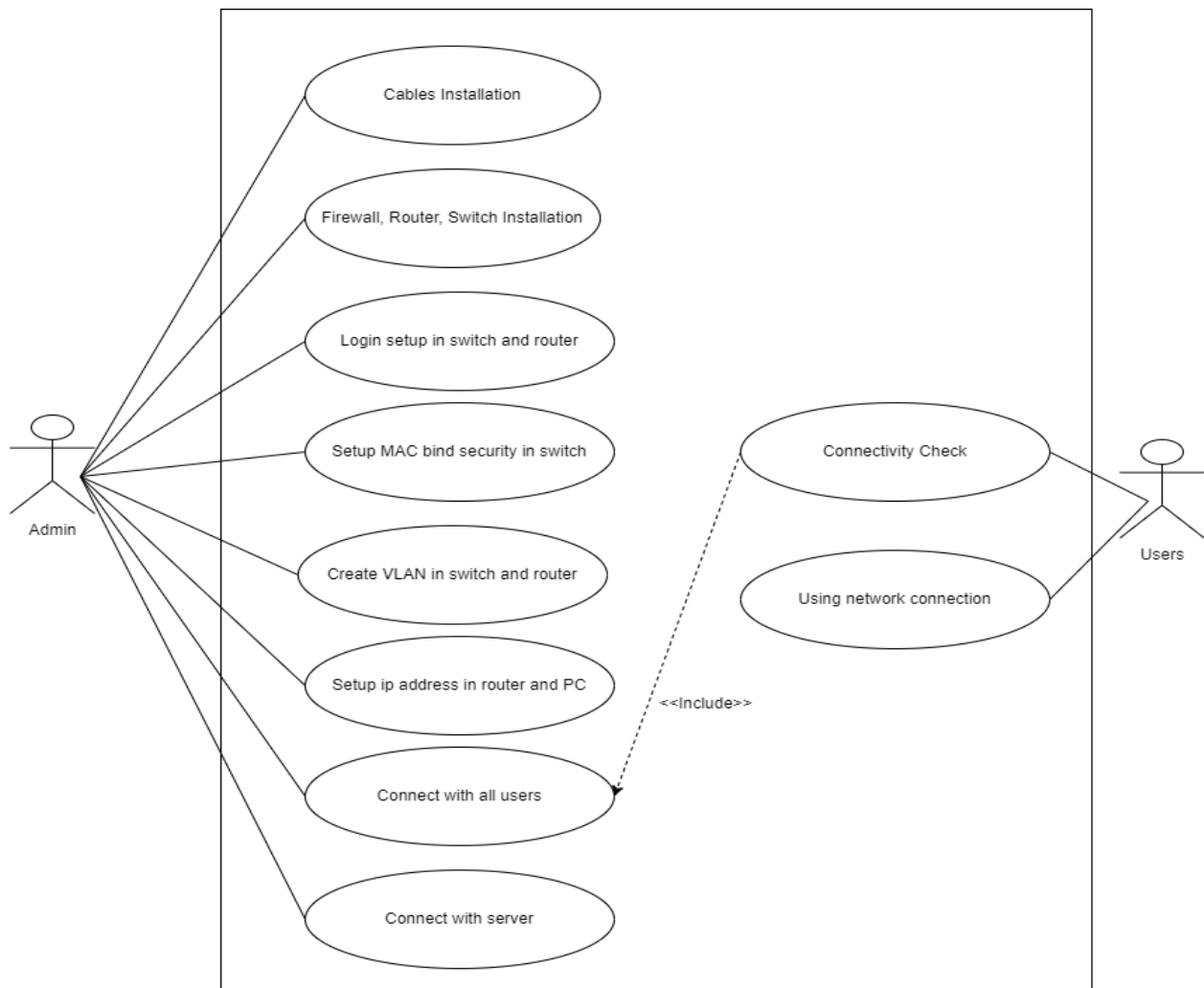
Fig 5.3.1a : Use case diagram for infrastructure design

Activity Diagram: The activity chart is an essential UML image to represent the energetic axes of the framework. A flowchart that depicts the progression of an activity from one movement to another is the action graph's basic form. One way to describe the movement is as a framework operation. These are the steps in the information center system's activity graph:

Fig 5.3.1b: Activity diagram for infrastructure design

5.3.2   Architecture

A network diagram shows how a network is structured visually. A variety of icons and line connections represent the topology of the network.

Part 1: From ISP to Router

First, I need the internet to connect all my components. That's why I use ISP to get an internet connection. Sometimes one ISP ma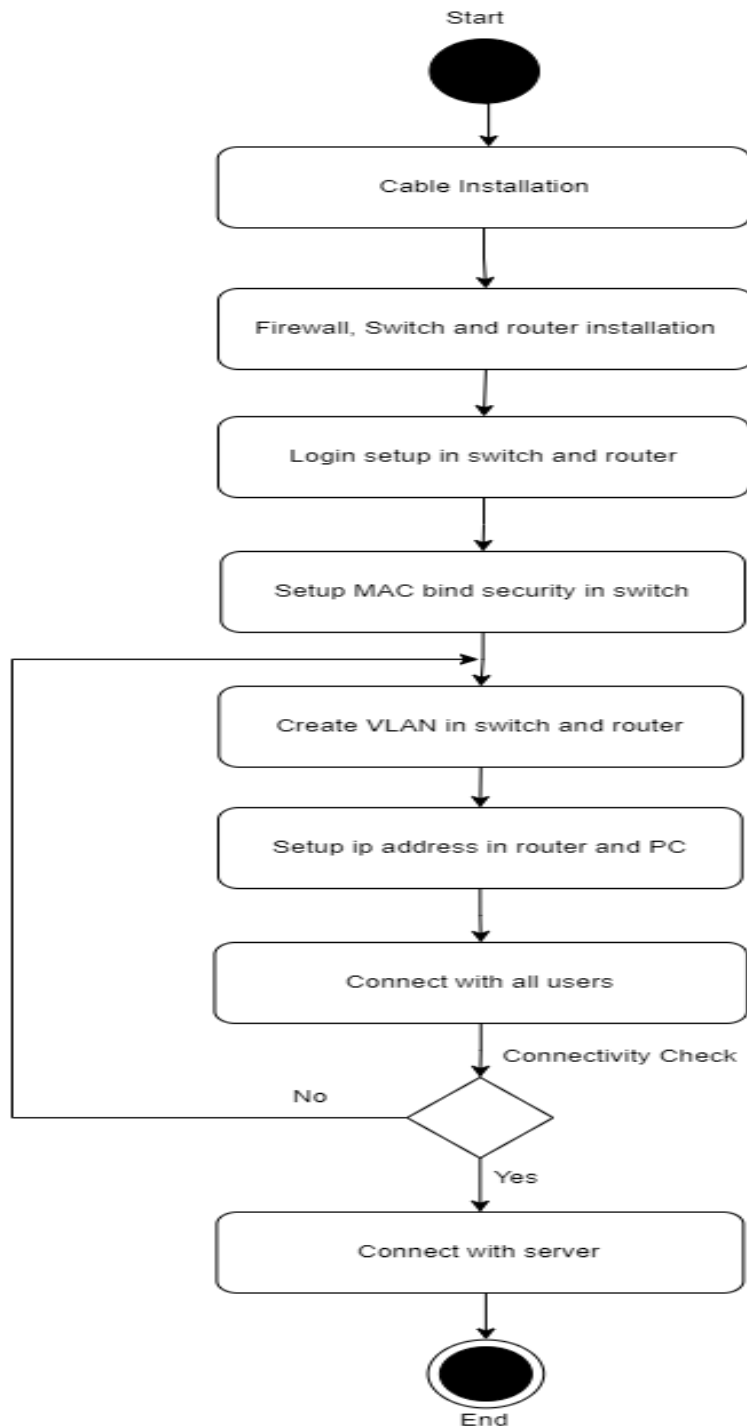y shut down, or the connection may be lost. That's why I use 2 ISP for substitution. But for security, I use firewalls because firewalls defend your computer or network from outside cyber attacks by blocking harmful or unnecessary network traffic. And also, for substitution, I use two firewalls. For the connection with ISP and firewall, I use fiber optic cable. After that, for internet flow control, reducing network traffic and sharing data, I need routers, and I use four routers for substitution. Because if one router loses the internet connection, no user can share their data, so not losing internet for a second, I have put a router as an alternative. And from the firewall to, all routers are connected with UTP cable.
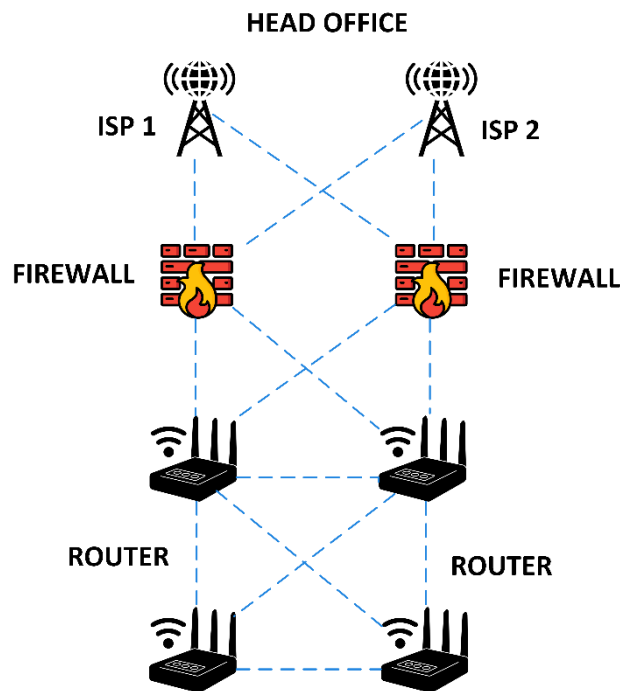
Fig: 5.3.2: ISP to router connection

Part 2: From Router to user connection

When router connections are made, I need switches because switches provide data sharing and transfer between devices, promoting network connection. For an office, there can be more branches, so they have a massive amount of users and data, so I need a 24 port core switch for the head office and branch office. The head office's core switch is connected with the branch office's core switch because if one core switch gets a problem, then the other switch overcomes it with an internet connection so that no users can face any problem. I use a UTP cable for the router to switch connections. After that, I use a 24 port distributed switch where the users as laptop, monitoring pc and server are connected. The server stores the data and transfers it to another user when needed. All connections are used with UTP cable.
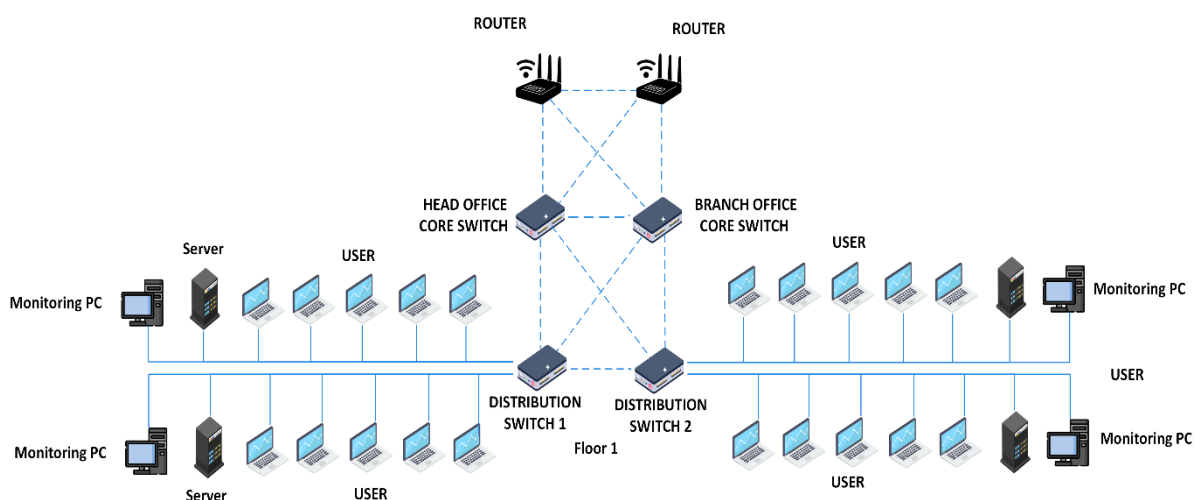
Fig 5.3.3: router to user connection

Part 3: Head office's switches and users

In office, there are 3 floors so I need two more switches and the users are connected with switches and all collections are connected with UTP cables.
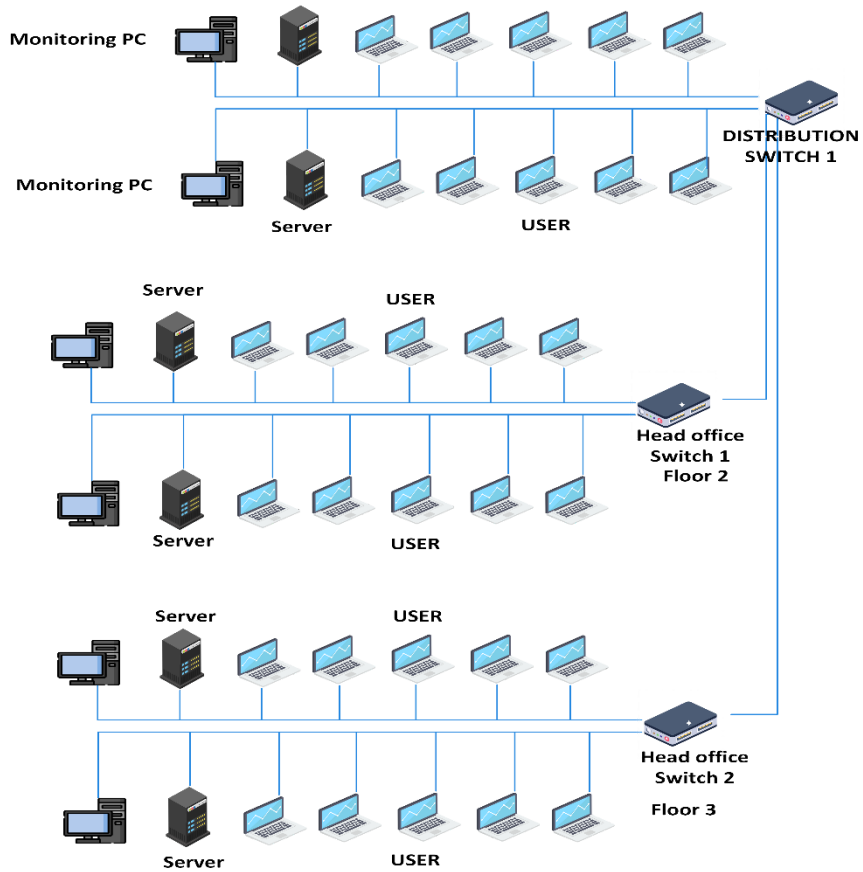
Fig 5.3.4: switch to user connection in head office

Part 4: Branch switch and user

In office, there are 4 branches so I need 4 more switches for the branch office and the users are connected with all switches and all connections are connected with UTP cables.
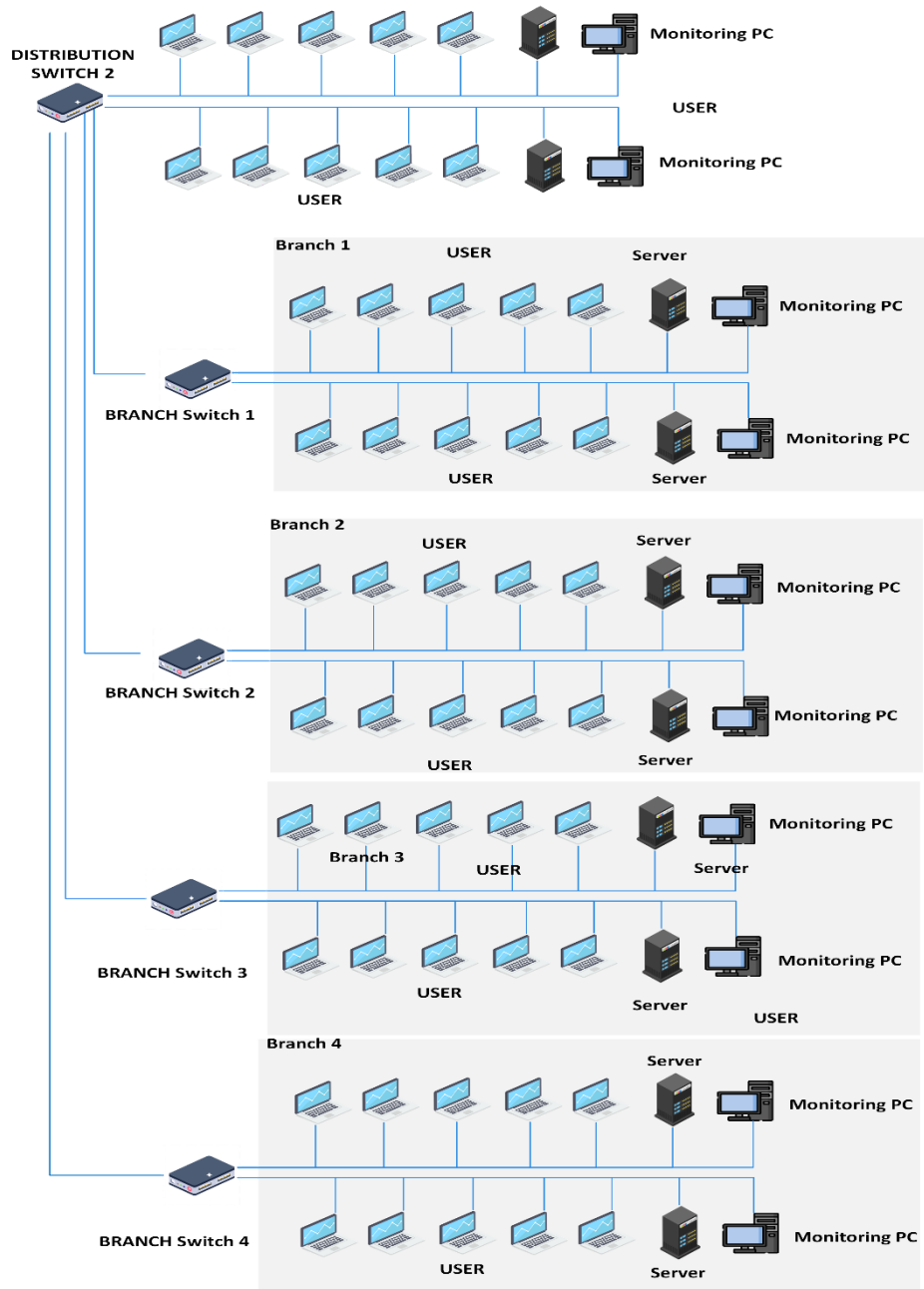
Fig 5.3.5: branch switch to user connection

Final Part: Full diagram of infrastructure design

Here is the full architecture of infrastructure design where all components can show and all elements are connected with optic fiber or UTP cable
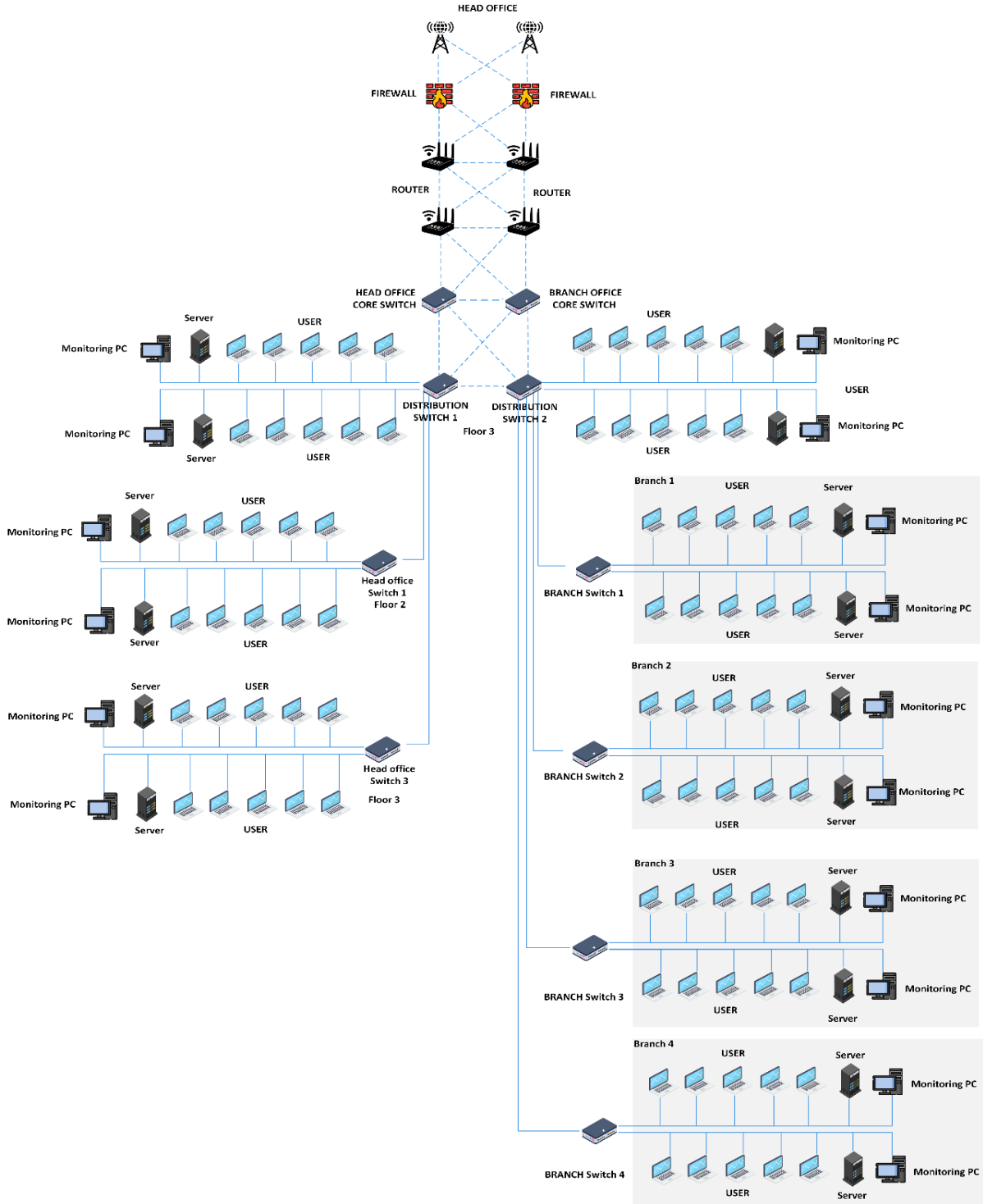
Fig 5.3.6: Architecture of infrastructure design

5.3.3   Implementation

Distributed Switch 1:

Login:

- First the switch needs to be enabled, and then it needs a hostname. So I create a hostname as GIL-sw1
- Then I put a password which is enabled as a secret because unauthorized people can't enter here. So I give a password which is GIL123
- For only one people login here, I use "line console 0", which means one person can log in, and for these people, I give a password which is GIL
- After that, login will start, and for giving the "login" line is needed.
- But for remote login, I use the "line vty 0 4" command. 0 4 means only five people can log in because cisco standard five people
- Again, I give the password, which is GIL123 and then the login command is used.
- Last, I have to write an exit command for login closing.

```
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname GIL-sw1
GIL-sw1(config)#enable secret GIL123
GIL-sw1(config)#line console 0
GIL-sw1(config)#line console 0
GIL-sw1(config-line)#password GIL
GIL-sw1(config-line)#login
GIL-sw1(config-line)#exit
GIL-sw1(config)#line vty 0 4
GIL-sw1(config-line)#password GIL123
GIL-sw1(config-line)#login
GIL-sw1(config-line)#exit
```

Ctrl+F6 to exit CLI focus   Copy   Paste

MAC bind security:

IP-MAC Binding allows you to bind an IP address to a MAC address and vice-versa. It only provides traffic when the host IP address matches a specified MAC address. This feature can protect your network from ARP poisoning attacks, in which hackers try to change the MAC address of their computers to match an actual device on your network. To use MAC address binding, you must configure the interface to associate a client IP address with a MAC address.

- First, I use the command the ports to mac security

- Then I use port mode access and enable the port security will enable

- I use one mac bind. That's why I give a maximum of 1, which will set in 1 port.

- I give the mac address sticky because sticky is not used for manual

- No unauthorized can log in I give a violation shutdown command so that if any unauthorized people want login here, the system will automatically shutdown

```
GIL-swl(config)#interface range fastEthernet 0/5-24
GIL-swl(config-if-range)#switchport mode access
GIL-swl(config-if-range)#switchport port-security
GIL-swl(config-if-range)#switchport port-security maximum 1
GIL-swl(config-if-range)#switchport port-security mac-address sticky
GIL-swl(config-if-range)#switchport port-security violation shutdown
GIL-swl(config-if-range)#shutdown
```

VLAN Create: VLANs allow network administrators to automatically limit access to a specified group of users by dividing workstations into different isolated LAN segments.

- Creating VLAN in PC 1 first, I declare the port number as interface FastEthernet 0/2

- I give a VLAN name as a description that "lan10-pc1."

- Then a vital command is "no shutdown, "meaning VLAN will go up.

- On this process continues 3 times, I create 4 Vlan in switch

```
GIL-swl(config-if)#exit
GIL-swl(config)#vlan 10
GIL-swl(config-vlan)#exit
GIL-swl(config)#vlan 20
GIL-swl(config-vlan)#exit
GIL-swl(config)#vlan 30
GIL-swl(config-vlan)#exit
GIL-swl(config)#interface fasrEthernet 0/2
                           ^
% Invalid input detected at '^' marker.

GIL-swl(config)#interface fastEthernet 0/2
GIL-swl(config-if)#description "lan10-pc1"
GIL-swl(config-if)#switchport mode access
GIL-swl(config-if)#switchport mode access vlan 10
                                          ^
% Invalid input detected at '^' marker.

GIL-swl(config-if)#switchport access vlan 10
GIL-swl(config-if)#no shutdown
GIL-swl(config-if)#exit
GIL-swl(config)#interface fastEthernet 0/3
GIL-swl(config-if)#description "lan20-pc1"
GIL-swl(config-if)#switchport mode access
GIL-swl(config-if)#switchport access vlan 20
GIL-swl(config-if)#no shutdown
GIL-swl(config-if)#exit
GIL-swl(config)#interface fastEthernet 0/4
GIL-swl(config-if)#description "lan30-pc1"
GIL-swl(config-if)#switchport mode access
GIL-swl(config-if)#switchport access vlan 30
GIL-swl(config-if)#no shutdown
```

Ctrl+F6 to exit CLI focus   Copy   Paste

Trunk mode: A trunk port allows sending all those signals for each switch or router across a single trunk link. In contrast to an access port, a trunk port must use tagging to allow signals to get to the correct endpoint. Trunk ports typically offer higher bandwidth and lower latency than access ports.

- For giving trunk mode, I have to declare how many ports will be used for trunk mode. That's why first I used this command: "interface range fastEthernet 0/1 -4."

- To enable trunk mode, I use the encapsulation dot1q command that the trunk is now enable

```
dist_switchl(config-if-range)#
dist_switchl(config-if-range)#exit
dist_switchl(config)#interface range fastEthernet 0/1-4
dist_switchl(config-if-range)#speed 100
dist_switchl(config-if-range)#duplex full
dist_switchl(config-if-range)#switchport tr
dist_switchl(config-if-range)#switchport trunk en
dist_switchl(config-if-range)#switchport trunk encapsulation dotlq
                                                     ^
% Invalid input detected at '^' marker.

dist_switchl(config-if-range)#switchport mode trunk
dist_switchl(config-if-range)#channel-protocol lacp
dist_switchl(config-if-range)#channel-group 1 mode active?
active
dist_switchl(config-if-range)#do wr
Building configuration...
[OK]
```

Router login:

- First the router needs to be enabled, and then it needs a hostname. So I create a hostname as GIL-rt1
- Then I put a password which is enabled as a secret because unauthorized people can't enter here. So I give a password which is GIL123
- For only one people login here, I use "line console 0", which means one person can log in, and for these people, I give a password which is GIL123
- After that, login will start, and for giving the "login" line is needed.
- But for remote login, I use the "line vty 0 4" command. 0 4 means only five people can log in because cisco standard five people
- Again, I give the password, which is GIL123 and then the login command is used.
- Last, I have to write an exit command for login closing.

```
Router>en
Router#cong t
          ^
% Invalid input detected at '^' marker.

Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname GIL-rt1
GIL-rt1(config)#enable secret GIL123
GIL-rt1(config)#line console 0
GIL-rt1(config-line)#password GIL123
GIL-rt1(config-line)#login
GIL-rt1(config-line)#exit
GIL-rt1(config)#line vty 0 4
GIL-rt1(config-line)#password GIL123
GIL-rt1(config-line)#login exit
                           ^
% Invalid input detected at '^' marker.

GIL-rt1(config-line)#login
GIL-rt1(config-line)#exit
```

Inter vlan and sub-intervlan in router: Network communication is forwarded from one VLAN to another VLAN via inter-VLAN routing.

- First we declare the port where we need to create an inter vlan.

- After that we need no shutdown command so that the interface will go up.

- Then we create sub interface for first vlan

- Last we give it an ip address

```
GIL-rtl(config)#interface fastethernet 0/1
GIL-rtl(config-if)#no shutdown

GIL-rtl(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up

GIL-rtl(config-if)#exit
GIL-rtl(config)#interface fastEthernet 0/1.10
GIL-rtl(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/1.10, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1.10, changed state to up

GIL-rtl(config-subif)#encapsulation dotlq 10
GIL-rtl(config-subif)#ip address 192.168.1.1 255.255.255.0
GIL-rtl(config-subif)#exit
```

Router vlan dhcp: DHCP reduces configuration mistakes by manually configuring IP addresses. There are 5 vlans, that's why we need to create 5 ip dhcp address

- First we declare vlan name, so we use pool command for declare vlan name

- After that we need that vlan's network

- For gateway I put default-router command

- Last we set dns-server and cisco there can be 1 dns server

```
GIL-rt1(config)#ip dhcp pool lan10
GIL-rt1(dhcp-config)#network 192.168.1.0 255.255.255.0
GIL-rt1(dhcp-config)#default-router 192.168.1.1
GIL-rt1(dhcp-config)#dns-server 8.8.8.8
GIL-rt1(dhcp-config)#exit
GIL-rt1(config)#ip dhcp pool lan20
GIL-rt1(dhcp-config)#network 192.168.2.0 255.255.255.0
GIL-rt1(dhcp-config)#default-router 192.168.2.1
GIL-rt1(dhcp-config)#dns-server 8.8.8.8
GIL-rt1(dhcp-config)#exit
GIL-rt1(config)#ip dhcp lan30
                          ^
% Invalid input detected at '^' marker.

GIL-rt1(config)#ip dhcp pool lan30
GIL-rt1(dhcp-config)#network 192.168.3.1 255.255.255.0
GIL-rt1(dhcp-config)#default-router 192.168.3.1
GIL-rt1(dhcp-config)#dns-server 8.8.8.8
GIL-rt1(dhcp-config)#exit
GIL-rt1(config)#ip dhcp pool lan40
GIL-rt1(dhcp-config)#network 192.168.4.0 255.255.255.0
GIL-rt1(dhcp-config)#default-router 192.168.4.1
GIL-rt1(dhcp-config)#dns-server 8.8.8.8
GIL-rt1(dhcp-config)#exit
GIL-rt1(config)#ip dhcp pool lan50
GIL-rt1(dhcp-config)#network 192.168.5.0 255.255.255.0
GIL-rt1(dhcp-config)#default-router 192.168.5.1
GIL-rt1(dhcp-config)#dns-server 8.8.8.8
GIL-rt1(dhcp-config)#exit
```
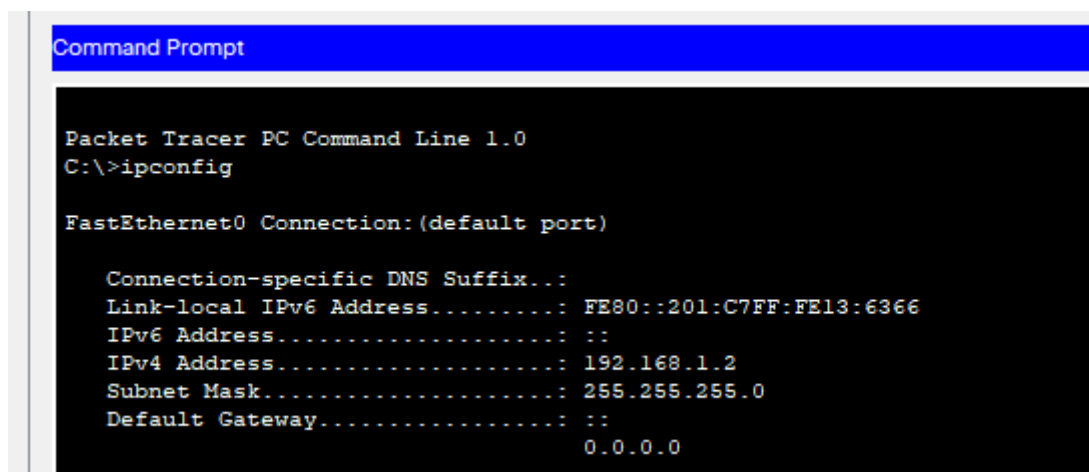
5.4   Testing

A network testing investigation is carried out to give stakeholders information regarding the quality of the product or service being tested. Because of the rising use of computer networks, the network test has been widely employed as one of the test formats and will continue to be an essential test format. However, security has received increased attention as the network test system has expanded. A network testing system with security features has been designed and deployed. Network testing should be performed ad hoc following a configuration change to ensure that everything goes smoothly and continuously via active network monitoring to discover network problems as they occur.

Outputs:

Switch Login output:

```
line con 0
 password GIL
 login
!
line vty 0 4
 password GIL123
 login
line vty 5 15
 login
!
!
!
!
end
```

PC IP address output:

```
Command Prompt

Packet Tracer PC Command Line 1.0
C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address..........: FE80::201:C7FF:FE13:6366
   IPv6 Address.....................: ::
   IPv4 Address.....................: 192.168.1.2
   Subnet Mask......................: 255.255.255.0
   Default Gateway..................: ::
                                      0.0.0.0
```

Chapter 6
Results & Analysis

The professional team with whom I worked on the project used a disciplined approach to develop a network that added value to the organization while remaining consistent with its aims and objectives. The system was effectively installed following an exhaustive testing phase focused on the organization's demands, purposes, and goals.

Design:

The result of making LAN network design:

- The network architecture is using the specific, making it easier to choose the appropriate hardware platforms, technological features, and protocols to implement the overview of the research design at a later time.

- As a result, the network is more adaptable to changing technical or business needs.

- The design will also re-design, upgrade, and modify any LAN network design components to make them more reliable and robust.

Configuration:

The results of configuration in cisco:

Switch Vlan output:

```
interface FastEthernet0/2
 description "lan10-pc1"
 switchport access vlan 10
 switchport mode access
!
interface FastEthernet0/3
 description "lan20-pc1"
 switchport access vlan 20
 switchport mode access
!
interface FastEthernet0/4
 description "lan30-pc1"
 switchport access vlan 30
 switchport mode access
!
```

Router ip address Output:

```
GIL-rt1(config)#do show ip int br
Interface              IP-Address      OK? Method Status                 Protocol
FastEthernet0/0        unassigned      YES unset  administratively down  down
FastEthernet0/1        unassigned      YES unset  up                     up
FastEthernet0/1.10     192.168.1.1     YES manual up                     up
FastEthernet0/1.20     192.168.2.1     YES manual up                     up
FastEthernet0/1.30     192.168.3.1     YES manual up                     up
FastEthernet0/1.40     192.168.4.1     YES manual up                     up
FastEthernet0/1.50     192.168.5.1     YES manual up                     up
Vlan1                  unassigned      YES unset  administratively down  down
```

Output of vlan dhcp in router:

```
hostname GIL-rt1
!
!
!
enable secret 5 $1$mERr$V8dKgljzV3y.5G6PFxhbD0
!
!
ip dhcp excluded-address 192.168.1.1 192.168.1.30
ip dhcp excluded-address 192.168.2.1 192.168.2.30
ip dhcp excluded-address 192.168.3.1 192.168.3.30
ip dhcp excluded-address 192.168.4.1 192.168.4.30
ip dhcp excluded-address 192.168.5.1 192.168.5.30
!
ip dhcp pool lan10
 network 192.168.1.0 255.255.255.0
 default-router 192.168.1.1
 dns-server 8.8.8.8
ip dhcp pool lan20
 network 192.168.2.0 255.255.255.0
 default-router 192.168.2.1
 dns-server 8.8.8.8
ip dhcp pool lan30
 network 192.168.3.0 255.255.255.0
 default-router 192.168.3.1
 dns-server 8.8.8.8
ip dhcp pool lan40
 network 192.168.4.0 255.255.255.0
 default-router 192.168.4.1
 dns-server 8.8.8.8
ip dhcp pool lan50
 network 192.168.5.0 255.255.255.0
 default-router 192.168.5.1
 dns-server 8.8.8.8
 --More--
```

Ctrl+F6 to exit CLI focus   Copy   Paste

Chapter 7
A Project as Engineering Problem Analysis

7.1   Sustainability of the Project/Work

A variety of factors influence the viability of the product/long-term project. The ability of a product to be improved and maintained is referred to as its sustainability. Understanding sustainability ideas and developing a sound plan are critical to preventing project failure. The product's sustainability can be divided into three categories:

- **Community sustainability:**
  This refers to the extent to which the community—or the officers who will use the network—will support the project's continued existence over time. Our service will remain available if we can efficiently utilize the technological infrastructure and network services.

- **Financial Sustainability:**
  Our Company's pricing for building the network creates a profit and covers all costs associated with keeping the service operational. By doing this, the company will be able to maintain its financial stability and generate profits in the future.

- **Organizational Supportability:**
  Its organization consistently develops our administrations with the help of our employees, who constantly work to advance their organizing knowledge and skills.

7.2   Social and Environmental Effects and Analysis

In our daily lives, organization is essential. With organized organizations, most companies, corporate offices, banks, schools, and, eventually, most houses are functional. Since systems are the basis for innovation, every project our company undertakes has social and natural implications.

- **Social Effect:**
  The project we are working on will benefit the GIL staff socially. The daily grind of work will be more straightforward and more effective. The ease with which information can be transmitted is improved by our system's ability to enable seamless connectivity between offices in various regions. Better data-sharing accuracy will also benefit the company's dependent customers, the most influential group.

- **Environmental Effect:**
  Environmental responsibility is increasingly a prerequisite for doing business. Environmental opportunities and dangers currently challenge corporate strategy and operating models across all industries and activities. In today's fiercely competitive market, decisions about ecological design, as part of a broader sustainability plan, are increasingly defining a company's prospects. Due to their stringent policies to prioritize

social and environmental impact, it has been evident from the start of this project that the company where I performed my internship is highly concerned about it.

7.3   Addressing Ethics and Ethical Issues

Technology permeates every aspect of our world today. Data is one of the essential parts of any business or organization. Information is one of a company's most critical components. Hacking, cybercrime, and data theft have all sharply grown with the development of technology. Many unsaid norms and moral standards must be adhered to when working on the design and implementation of networks for any organization. As a result, it's crucial to consider all potential attack routes when designing carefully.

- **Organizing:**
  By being well-planned, meaningful, and beneficial, a utilitarian moral organization ensures that your networking does not waste the time of your clients. The business successfully provided the promised organizational gear and is currently providing the office with the actual transmission capacity requirements.

- **Enthusiastic Organization:**
  Moral passionate organizing enables people to understand why they must be moral with ease rather than merely adhering to a rule. If our clients don't fully understand the issues, they won't be able to make ethical decisions. As a result, we make it a point to explain the consequences so that the other party is aware of what would happen if an unethical decision is made.

- **Ethical organizing:**
  The traits of high-minded organizing include acting with great assurance, enjoying yourself, and showing an interest in permitted activities. Along with the corresponding exchange of data, information, and assets, it also has a significant moral impact on internal arrangements.

Chapter 8
Lesson Learned

8.1   Problems Faced During this Period

The difficulties that were identified, investigated, and ultimately resolved are covered in this section. The problems that have been noted are as follows:

- **Poor internet:**
  For offices to operate smoothly, a strong internet connection may be necessary. Therefore, we must make sure that the required web speeds deliver.

- **Timely IP address change:**
  the main page does not function when the IP address changes. It is a significant issue.

- **Server goes offline unexpectedly:**
  Strong server connections are more crucial.

8.2   Solution of those Problems

The following list provides the fixes for the issues that have been identified:

- **Solution of poor internet:**
  The office's fibers association, which contains a 100 Mbps web transfer speed, will provide clients with an essentially smoother and faster working experience. This is a solution for slow internet. A dependable and consistent speed will also be ensured by the use of premium 4-core strands during the network's construction.

- **IP address change solution:**
  If the IP address is dynamic, it will change. This requires changing the IP address from dynamic to static.

- If the server is down, the problem can be addressed from the office.

Chapter 9

Future Works & Conclusion

9.1   Future Works

My experience as an intern at GIL Office has inspired me to pursue a career in organizational design. Working in a network-based business provided an important learning opportunity for the capabilities of work in the Computer Networks sector, which includes a vast array of commercial activities. I completed the first phase of the project. I will upgrade and update my project in future. We planning for next phases are:

- **Add Access point(AP):**
  I'll add access points(AP) to my local area network to make it larger.

- **Monitoring System:**
  I'll monitor the access points system and control it.

- **Upgrade Security System:**
  I'll give more security system components that can be more effective for a company to protect their data.

- **Extend more configuration:**
  To make it run more smoothly and faster, I'll extend more configurations in the router for the users.

9.2   Conclusion

Global Informatics Limited provided me with a wonderful learning opportunity during my internship. Since my home and workplace are so far apart. It was difficult to make the commitment to go to work during regular hours, but it improved my time management and communication skills.

I had the chance to experience the structure of LAN design and configuration for my internship. I gained knowledge and practical expertise in a range of network design-related professional sectors throughout my internship. Despite their hectic schedules, my director, supervisor, and coworkers were incredibly helpful in supporting me as I adapted to the new workplace. I was able to work with my more seasoned coworkers to address issues and overcome personal challenges while I was an intern. Thankfully, I was able to take part in several meetings with top management where we talked about the goals, demands, and needs of the organization as well as the price and timetable of the project.

This internship also gave me the opportunity to learn about LAN management and teamwork. I would like to express my appreciation to everybody to make my internship a success.

Chapter 10

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  Atomic Energy Commission, E-12/A, Agargaon, Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh
  https://www.academia.edu/78689882/Design_Deployment_and_Implementation_of_Local_Area_Network_LAN_at_BAEC_Head_Quarter_

Consent Paper

An Undergraduate Internship on my topic
Network Infrastructure Design(LAN)

By

Farjana Nur Mahin

Student ID: **1821516**

Autumn, 2022

Consent from Supervisor

The student modified the internship final report as per the recommendations made by her academic supervisor and/or panel members during and/or before final viva, and the department can use this version for archiving as well as the OBE course material for CSE499.

(Signature of the Supervisor)

Md. Abu Sayed

Department of Computer Science & Engineering

Independent University, Bangladesh