Kurdistan Regional Government

Ministry Of Education
G.D. OF Institution

Kirkuk Private Institute of Computer Science

Management Local Network

A graduation project is submitted to the council of Kirkuk Private Institute for Computer Science in partial fulfillment of the requirements for the degree of diploma in Computer Science Program Department

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2023-2024

بسم الله الرحمن الرحيم

((قُلْ هَلْ يَسْتَوِي الَّذِينَ يَعْلَمُونَ وَالَّذِينَ لَا يَعْلَمُونَ إِنَّمَا يَتَذَكَّرُ أُولُو الْأَلْبَابِ))

صدق الله العظيم

((سورة الزمر: الآية 9))

Acceptance Letter

Research Title: Management Local Network

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This project that has been done, which contains all the academic and scientific requirements, is submitted to the Private Computer Institute of Kirkuk.

Academic supervisor

Mr. Arkan Abbas Mohammed

Dedication

This thesis is dedicated to:

I dedicate my dissertation work to my family and many friends. A special feeling of gratitude to my loving parents whose words of encouragement and push for tenacity ring in my ears.

I also dedicate this dissertation to my many friends who have supported me throughout the process. I will always appreciate all they have done.

Acknowledgments

I wish to thank my project members who were more than generous with their expertise and precious time. A special thanks to Miss. Hanan Fadhil, my Project supervisor for his countless hours of reflecting, reading, encouraging, and most of all patience throughout the entire process.

I would like to acknowledge and thank my Instituted division for allowing me to conduct my research and providing any assistance requested.

Finally, I would like to thank the teachers, in Instituted in network division that assisted me with this project. Their excitement and willingness to provide feedback made the completion of this research an enjoyable experience.

Abstract

Local area networks (LAN) are, by definition, internal communications networks for any organization, and therefore they are usually used, built, and maintained internally, and in the design that we made in the Cisco Packet Tracer program, it is a design for a house or any place consisting of two floors, two rooms, or any two different places for each Among them there are the same devices and it consists of several computers, a switch, a wireless router to connect mobile devices or tablets, as well as the main Cisco router, and the two routers are connected via a cable (Serial DTE) and the two routers were programmed via (Static). On the other floor are the same devices and programming, but they differ in the type of IP Address, each floor has its own. The IP address is different so that there is no conflict in information.

Keywords: LAN, Networking, Local area networks, networks, Cisco Packet Tracer.

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Table of Abbreviations

Abbreviation	Description
LAN	Local Area Network
PAN	Personal Area Network
WAN	Wide Area Network
NFC	near-field connectivity
IDC	International Data Corporation
Linux	Lovable Intellect Not Using XP
MacOS	Macintosh Operating System
IOS	iPhone Operating System
CCNA	Cisco Certified Network Associate
SMTP	Simple Mail Transfer Protocol
IBM	International Business Machines
P2P	Peer to Peer
IEEE	Institute of Electrical and Electronics Engineers
MAN	Metropolitan Area Network
ARC	Attached Resource Computer
WLAN	Wireless Local Area Network
ATM	Asynchronous Transfer Mode
OSI	Open Systems Interconnection
IP	Internet Protocol
CLI	Command Line Interface
GUI	Graphical User Interface

Chapter One

Introduction

1.1. Local Area Network (LAN)

A local area network (LAN) is a connected environment spanning one or more buildings – typically in a one-kilometer radius – that links computing devices within close proximity of each other by using Ethernet and Wi-Fi technology. LAN is among the most foundational components of the global networked landscape, both at consumer and enterprise levels.

In 1974, Cambridge University developed the Cambridge Ring, which helped connect the computing devices used within the university campus. Xerox came up with an early version of Ethernet between 1973 and 1974.
The first LAN installation viable at scale was 1979's electronic voting systems for the European Parliament, where LAN was used to connect 400+ microprocessor-enabled voting terminals.

Until the 1980s, LAN remained limited to research, education, the public sector, and defense applications. From the 1990s, the rise of affordable PCs and wider accessibility of the internet made LAN implementations more commonplace. Today, nearly every networked location relies on LAN in some way or the other across urban residential areas, office locations, factories, etc.

In terms of hierarchy, LAN covers more area than a personal area network (PAN), which connects nearby devices using Bluetooth or Wi-Fi, and nearfield connectivity (NFC). It is also less expensive than a metropolitan area network (MAN) which covers entire cities and a wide area network (WAN) which connects multiple cities or regions using the same secured line.

Most leading telecom carriers offer LAN solutions to their consumer and enterprise users to connect their personal and professional devices for daily

internet usage. LAN access enables remote collaboration, online shopping, cloud-based media consumption, cloud storage, data exchange from wearable's, and a host of other use cases.

This is why the demand for LAN is constantly growing, despite being a mature market. According to Industry Research, both wired and wireless LAN segments have grown in recent years, particularly in the wake of COVID-19. In Q1 of 2021, revenues in the enterprise segment of wireless LAN grew by 24.6%, as per IDC reports. In other words, LAN continues to be a prominent technology in enterprise stacks, nearly 50 years after it was first developed in the 1970s.

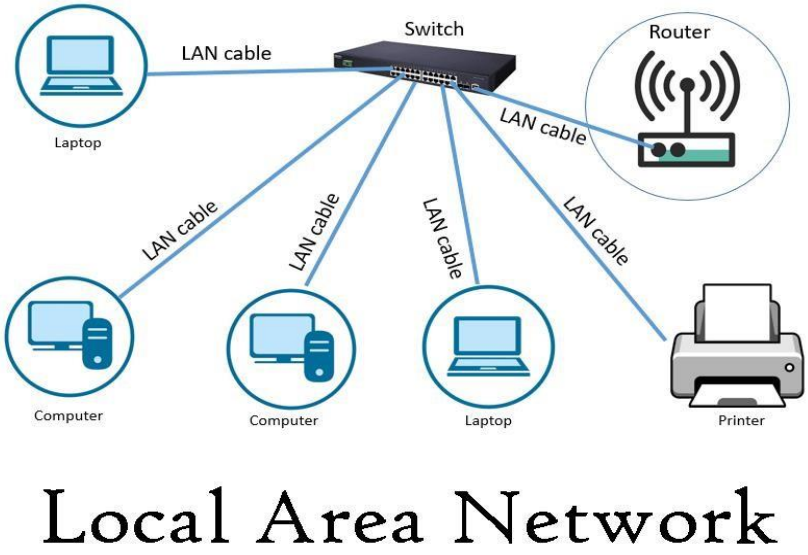

Figure 1.1: Local Area Network

1.2.Research Objective

The goal of the project is to build a site network system for any place, building or company using the Cisco Packet Tracer program before starting to build the system in the building or company and discover errors in connectivity, programming, required devices, total cost and necessary wires.

1.3. problem

The problem with the simulation programs is that they are not 100 % efficient, and it is possible that some problems may arise during application in reality. However, the simulator remains good most of the time in identifying possible errors that may occur in reality.

1.4. PROPOSED SOLUTION

To avoid this danger, one must not rely entirely on the simulated program, and the errors contained should be taken into account and avoided during design and implementation.

1.5.Types of (LAN):

Local area networks can be classified based on the types of devices they connect, the design of the underlying architecture, and the medium used. There's also an emerging LAN market that's native to the cloud era.

1.5.1.Client-server LAN

he client-server model describes how a server gives one or more clients access to resources and services. Mail servers, web servers, and file servers are examples of servers. Client devices, including desktops, laptops, tablets, and mobile devices, have access to the resources on each of these servers. Clients and servers often have a one-to-many connection, which means that a single server can supply resources to several clients at the same time.

When a client requests a connection with a server, the server has the option of accepting or rejecting the request. If the connection is accepted, the server builds and maintains a protocol-specific connection with the client.

To send a message, for instance, an email client may demand an SMTP connection to a mail server. The mail server's SMTP program will then request authentication information, such as the email address and password. The server will deliver the email to the designated recipient if the credentials match an account on the mail server.

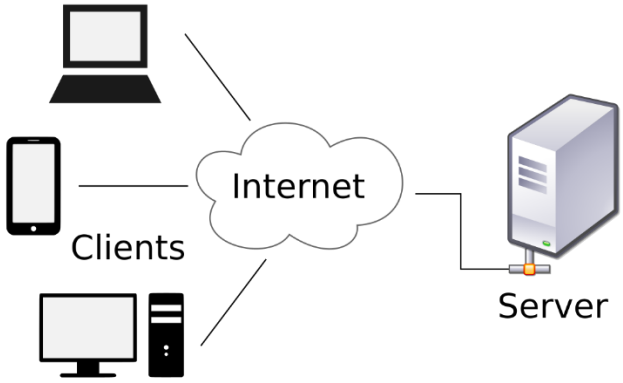

Figure 1.2 Cisco Packet Tracer Tools

1.5.2.Peer to peer

Peer-to-peer (P2P) computing or networking is a distributed application architecture that partitions tasks or workloads between peers. Peers are equally privileged, equipotent participants in the network, forming a peer-to-peer network of nodes.[1]

Peers make a portion of their resources, such as processing power, disk storage, or network bandwidth, directly available to other network participants, without the need for central coordination by servers or stable hosts.[2] Peers are both suppliers and consumers of resources, in contrast to the traditional client–server model in which the consumption and supply of resources are divided.

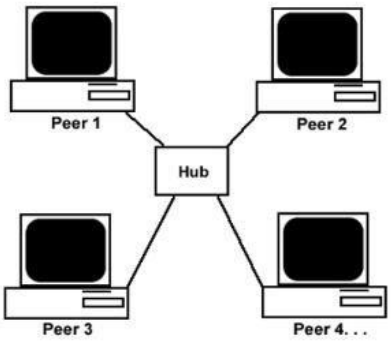

Figure 1.3 Peer to peer

1.5.3.Token ring

Token Ring is a physical and data link layer computer networking technology used to build local area networks. It was introduced by IBM in 1984, and standardized in 1989 as IEEE 802.5. It uses a special three-byte frame called a token that is passed around a logical ring of workstations or servers. This token passing is a channel access method providing fair access for all stations, and eliminating the collisions of contention-based access methods.

Token Ring was a successful technology, particularly in corporate environments, but was gradually eclipsed by the later versions of Ethernet. Gigabit Token Ring was standardized in 2001, but development has stopped since.

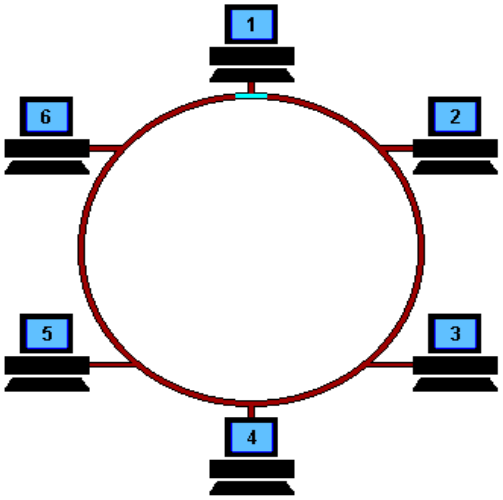

Figure 1.4 ring LAN

1.5.4.Token bus

In a token bus LAN, connected nodes are arranged in a tree-like topology, and tokens are transferred either left or right. Typically, it provides better bandwidth capacities than a token ring LAN environment.

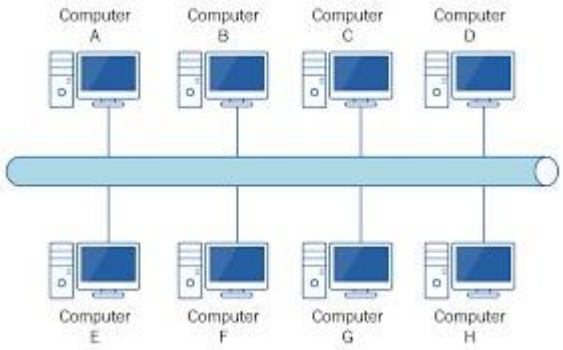

Figure 1.5.4. bus LAN

1.6.Related Work :

1.6.1.A SURVEY OF MODELS FOR COMPUTER NETWORKS MANAGEMENT, Dimitris Kontoudis, and Panayotis Fouliras, Department of Applied Informatics, University of Macedonia, Thessaloniki, Greece, May 2014:

The virtualization concept along with its underlying technologies has been warmly adopted in many fields of computer science. In this direction, network virtualization research has presented considerable results. In a parallel development, the convergence of two distinct worlds, communications and computing, has increased the use of computing server resources (virtual machines and hypervisors acting as active network elements) in network implementations. As a result, the level of detail and complexity in such architectures has increased and new challenges need to be taken into account for effective network management. Information and data models facilitate infrastructure representation and management and have been used extensively in that direction.

1.6.2.Computer network development to achieve resource sharing, Barry D. Wessler and Lawrence G. Roberts, May 1970 : In this paper a computer network is defined to be a set of autonomous, independent computer systems, interconnected so as to permit interactive resource sharing between any pair of systems. An overview of the need for a computer network, the requirements of a computer communication system, a description of the properties of the communication system chosen, and the potential uses of such a network are described in this paper.

1.6.3. Computer networks virtualization with GNS3: Evaluating a solution to optimize resources and achieve a distance learning, Pablo Gil; Gabriel J. Garcia; Angel Delgado; Rosa M. Medina; Antonio Calderón; Patricia Marti,2014: Designing educational resources allow students to modify their learning process. In particular, on-line and downloadable educational resources have been successfully used in engineering education the last years . Usually, these resources are free and accessible from web. In addition, they are designed and developed by lecturers and used by their students. But, they are rarely developed by students in order to be used by other students. In this work-in-progress, lecturers and students are working together to implement educational resources, which can be used by students to improve the learning process of computer networks subject in engineering studies. In particular, network topologies to model LAN (Local Area Network) and MAN (Metropolitan Area Network) are virtualized in order to simulate the behavior of the links and nodes when they are interconnected with different physical and logical design.

Chapter Two

Background Research and requirements

2.1 History of LAN

The history of Local Area Networks (LANs) is a fascinating journey that traces back to the early days of computer networking. Here's a brief overview:

Birth of LANs (1960s-1970s): The concept of LANs emerged in the 1960s and 1970s with the advent of time-sharing systems and the need to share resources (like printers and storage) among multiple users. Early LANs were often based on technologies like the RS-232 serial interface and were limited in range and speed.

Ethernet (1970s-1980s): Ethernet, developed by Xerox PARC in the early 1970s, became a pivotal technology in the history of LANs. Robert Metcalfe, one of the inventors of Ethernet, famously wrote a memo in 1976 outlining the Ethernet concept. This led to the development of the first Ethernet standard (10BASE5) and the founding of 3Com Corporation in 1979 to commercialize Ethernet products.

Standardization (1980s-1990s): The IEEE 802 project, started in the early 1980s, played a crucial role in standardizing LAN technologies. The IEEE 802.3 standard for Ethernet and the IEEE 802.5 standard for Token Ring were among the first LAN standards developed under this project. Standardization helped drive interoperability and the widespread adoption of LANs.

Ethernet Evolution (1990s-Present): Throughout the 1990s and into the 2000s, Ethernet continued to evolve, with faster speeds (Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet) and improved technologies (like switched Ethernet) becoming commonplace. These advancements fueled the growth of LANs and enabled them to support increasingly demanding applications.

Wireless LANs (Wi-Fi) (1990s-Present): The 1990s saw the emergence of wireless LANs (Wi-Fi) as a popular alternative to wired Ethernet. The IEEE 802.11 standards, starting with 802.11a and 802.11b, paved the way for wireless networking. Wi-Fi has since become a ubiquitous technology, enabling flexible and mobile connectivity.

LANs in the Internet Age (2000s-Present): In the 2000s and beyond, LANs have continued to evolve alongside the growth of the Internet. LANs are now used not just for local resource sharing but also for connecting to the Internet and cloud services. Virtual LANs (VLANs) have also become common, allowing for network segmentation and improved security.

2.2. Development Of LAN

The development of Local Area Networks (LANs) has evolved significantly over the years. Here is a brief overview of the key stages in their development:

Early LANs (1970s-1980s): LANs began to emerge in the 1970s with the introduction of Ethernet by Xerox, which later became the predominant LAN technology. Other early LAN technologies included Token Ring and ARCNET. LANs at this time were primarily used within individual organizations and were often based on proprietary technologies.

Standardization (1980s-1990s): In the 1980s and 1990s, LAN technologies began to be standardized. Ethernet, in particular, became standardized under the IEEE 802.3 standard. This led to greater interoperability between different vendors' equipment and the widespread adoption of Ethernet as the dominant LAN technology.

Advancements in Speed and Capacity (1990s-2000s): Throughout the 1990s and 2000s, LANs saw significant advancements in speed and capacity. Ethernet speeds increased from 10 Mbps (10BASE-T) to 100 Mbps (Fast Ethernet), 1 Gbps (Gigabit Ethernet), and eventually 10 Gbps and beyond. This allowed LANs to support increasingly demanding applications and higher volumes of data traffic.

Wireless LANs (Wi-Fi) (2000s-Present): The 2000s saw the rise of wireless LANs (Wi-Fi) as a popular alternative to wired Ethernet. Wi-Fi enables devices to connect to a LAN without the need for physical cables, providing greater flexibility and mobility. Wi-Fi has since become ubiquitous in both home and enterprise environments.

Cloud Computing and Virtualization (2010s-Present): In recent years, the development of LANs has been influenced by trends such as cloud computing and virtualization. LANs are now increasingly used to connect devices to cloud services, and virtual LANs (VLANs) are used to segment LAN traffic in large networks for security and performance reasons.

Future Trends: Looking ahead, LANs are likely to continue evolving to support emerging technologies such as Internet of Things (IoT), 5G, and edge computing. LANs will need to become more scalable, secure, and flexible to meet the demands of these technologies.

2.3. Requirement:

Any network consists of several architectural components that are the basis for the work of any network, without which it will not work at all. These components include:

2.3.1. Hardware Requirement:

2.3.2. Wired end-user devices

An average LAN environment will have a mix of both wired and wireless devices. Remember that we are talking about end-user devices here, such as laptops, desktops, smart televisions, smart monitors, collaboration hardware, meeting room systems, and the like. These devices will have an Ethernet port through which you can plug in the local area network directly into the device itself. Wired end-user devices typically enjoy high-speed internet connectivity, high-quality media streaming, and fast processing.

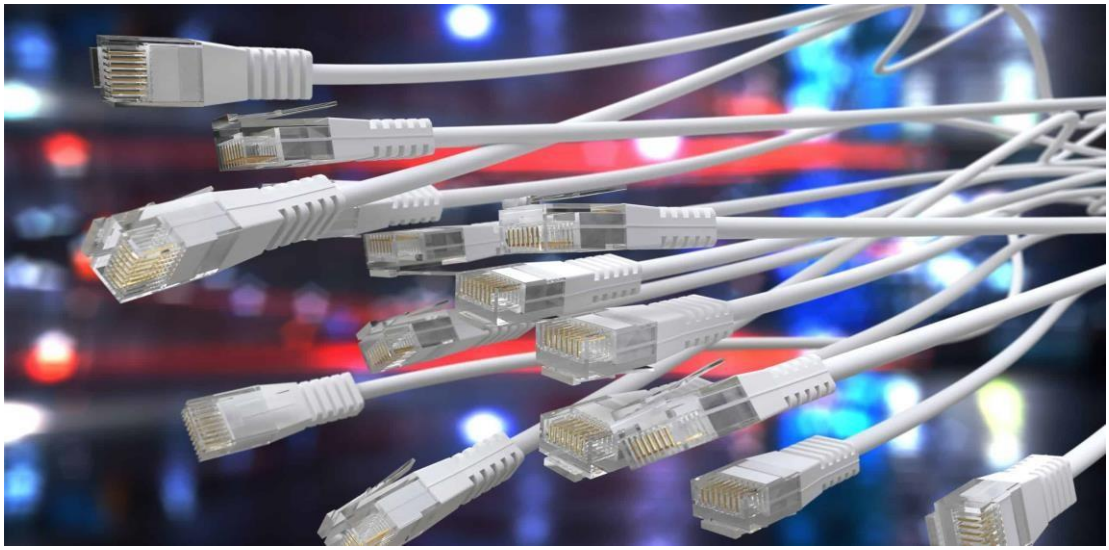

Figure 2.1 Wired end-user devices

2.3.3. cisco router:

Just as a switch connects multiple devices to create a network, a router connects multiple switches, and their respective networks, to form an even larger network. These networks may be in a single location or across multiple locations. When building a small business network, you will need one or more routers. In addition to connecting multiple networks together, the router also allows networked devices and multiple users to access the Internet.

Ultimately, a router works as a dispatcher, directing traffic and choosing the most efficient route for information, in the form of data packets, to travel across a network. A router connects your business to the world, protects information from security threats, and even decides which devices have priority over others.

Figure 2.2 Mobile end-user devices

2.3.4. Network switch(es) network switch is a physical device that operates at the Data Link layer of the Open Systems Interconnection (OSI) model — Layer 2. It takes in packets sent by devices that are connected to its physical ports, and forwards them to the devices the packets are intended to reach. Switches can also operate at the Network Layer (Layer 3) where routing occurs.

Switches are a common component of networks based on Ethernet, Fibre Channel, Asynchronous Transfer Mode (ATM), and InfiniBand, among others. However, most switches today use Ethernet.

Figure 2.3.cisco switch

2.4.1. Software Requirement:

2.4.2. Cisco Packet Tracer:

Cisco Packet Tracer is Cisco's simulation software. It can be used to create complicated network typologies, as well as to test and simulate abstract networking concepts. It acts as a playground for you to explore networking and the experience is very close to what you see in computer networks.

They also provide their service in languages such as Russian, German, Spanish and French. Packet Tracer enables students to create complicated and huge networks, which is frequently impossible with physical hardware due to cost considerations. Packet Tracer is available for Linux, Windows, MacOS, Android, and iOS.

Packet Tracer allows users to drag and drop routers, switches, and other network devices to create simulated network topologies. If you have a Netacad account, you can download it for free.

The best way to learn about networking, according to Cisco, is to do it. This programme cannot replace hardware routers or switches because the protocols are implemented solely in software. This tool, however, does not just contain Cisco hardware but also a wide range of other networking devices.

Figure 2.4.: Cisco Packet Tracer

As in any application program, the interface consists of several parts. At the top, there are menus and well-known tools such as New, and it is intended to start a new page to build a network. New, open, copy, save, print, etc., which every user of Windows programs is accustomed to knowing about its functions. As for what concerns us, it is the lower part of the window that contains a timer for the duration of the program's work, and a set of icons for devices, wires, and networking tools. In short, you can click on any of them and choose the appropriate model and drag it to the center of the window, which is The white part of the window used to build, design and check networks of various types, as in the following example :

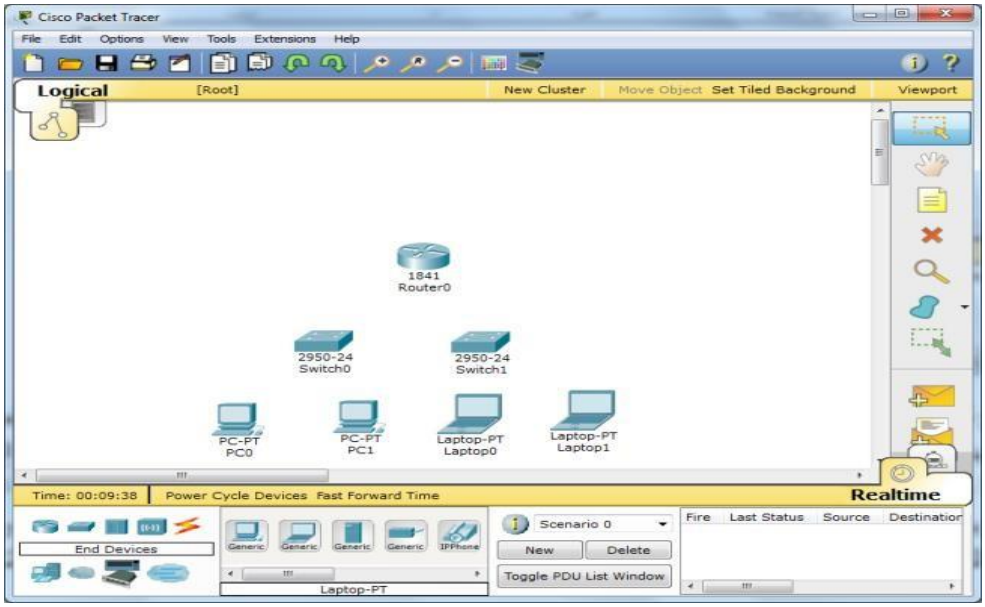

Figure 2.5Program tools

In the above window, one router, two adapters, and four computers, two desktops and twolaptops , were listed. Regarding the symbols used in Cisco networks, there are fixed graphics and icons to indicate each device, and for simplicity, we include below some of them:

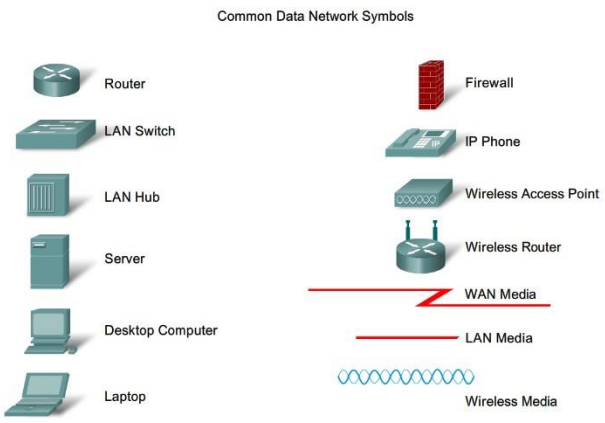

Figure 2.6 Cisco Packet Tracer Tools

1.4.3. Cisco Packet Tracer 8.2 IoT:

Cisco has finally announced a newer version of Cisco Packet Tracer and they've made some great changes in user interface and support. The new Packet Tracer is loaded with many new features such as new hardware, IoT, sensors and programming languages. Students who are preparing for the CCNA Industrial exam can get huge benefits from the latest version.

Here, we list some of the changes and improvements in Cisco Packet Tracer 7.0.

Chapter Three

Methodology

3.1. METHODOLOGY:

The research seeks to explore the development life cycle of local area networks using a range of devices that support networking. A home or onsite workplace was chosen to be converted into a local area network by adding hardware to the software. Cisco Packet Tracer was used to develop the network platform because it provides a variety of network components. Which simulates a real network. The Cisco Packet Tracer program enables developers to view the flow of packets and perform an analysis of data packets sent in the local network. All computers and smart devices can be operated using the Cisco Packet Tracer program. To test the performance of the local network in the program, we send a message from the first side of the router to the second side of the router and note that It means to us that the operation was successful and the transmission was well and sound.

We notice that when we open the program, the basic interface of the program appears with all the basic components in it.

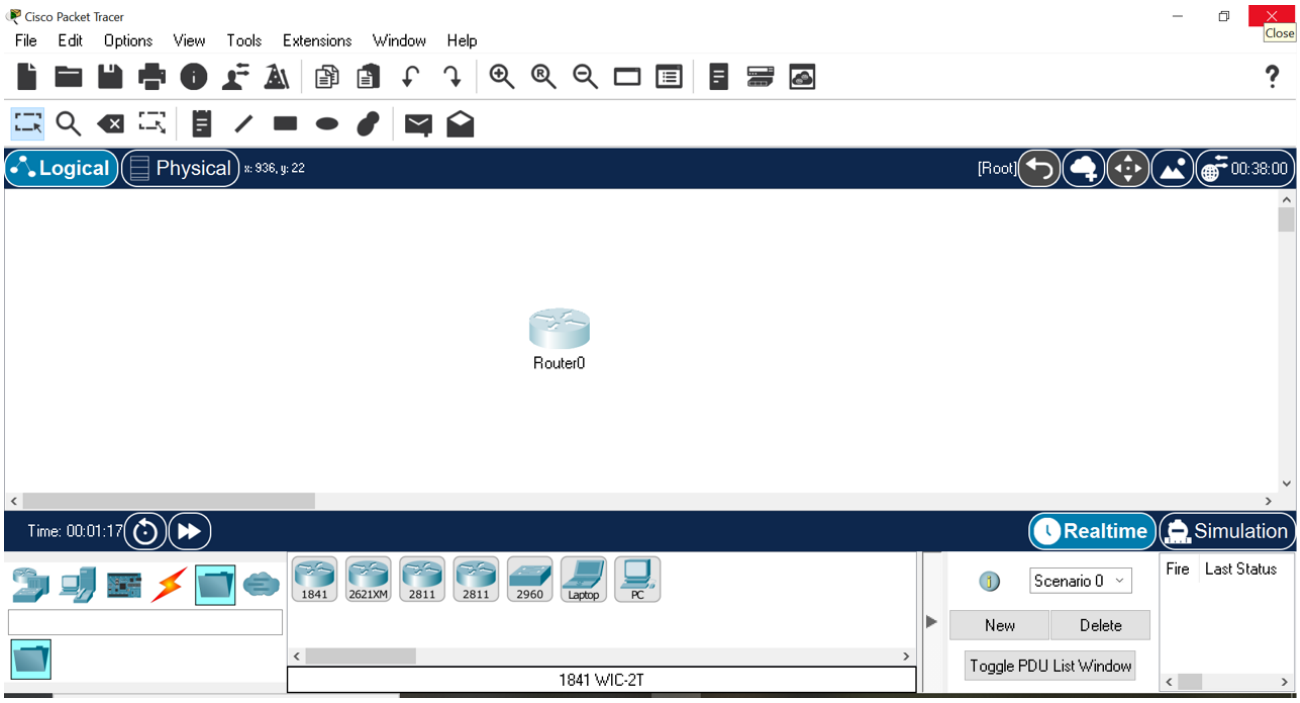

Figure 3.1. Cisco Packet Tracer

Bottom Left Corner has devices as usual. First, we have some new routers to start with. It is interesting that they have merged all the networking devices into a single tab. Click on that tab and it will show you all the networking devices available: Routers, Switches, Hubs, Firewall and other.

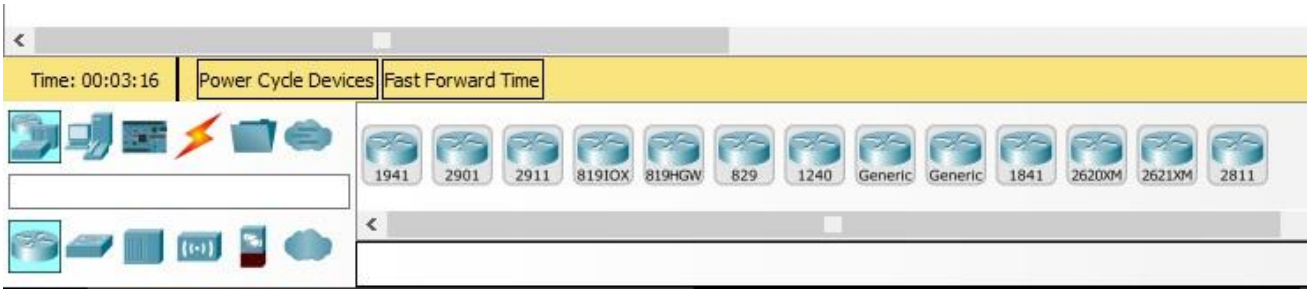

Figure 3.2. networking devices

Then we choose a router of type (Router-PT) because it contains inputs and outputs that suit our project

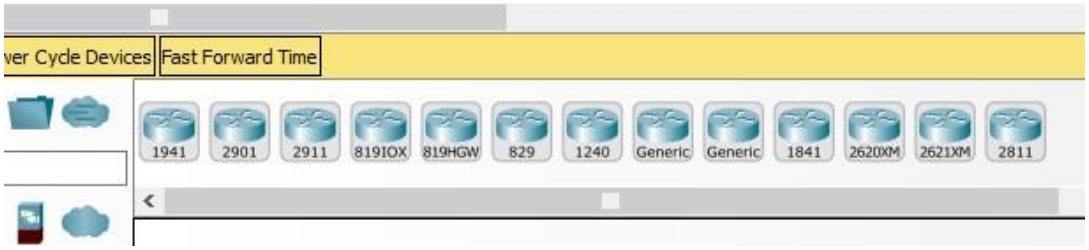

Figure 3.3. Router-PT

From the Network Devices section, we select the Wireless Devices section and choose a wireless router of the type (HomeRouter-PT-AC).

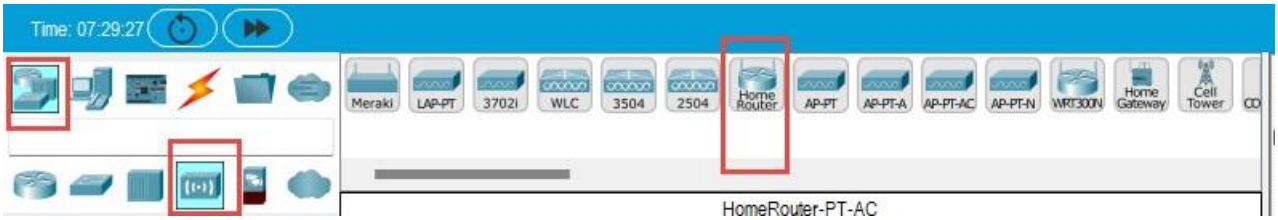

Figure 3.4. Homer outer-PT-AC

Then from the devices section, we choose several desktop or laptop computers and smart devices for wireless communication, such as a mobile phone.

After bringing all the devices, computers, switches and routers, we connect them between them and give each section an IP from A and B or from any other type and enter the addresses for all the devices and make sure not to repeat the IP to avoid mistakes and connect the computers with the switch of type (Straight Through Cable) and connect the two routers with some of the type (Serial) , The other type is a wireless connection

Figure 3.5. Copper Straight-Through connector

This is the design after connecting the devices and completing the addresses for each device.

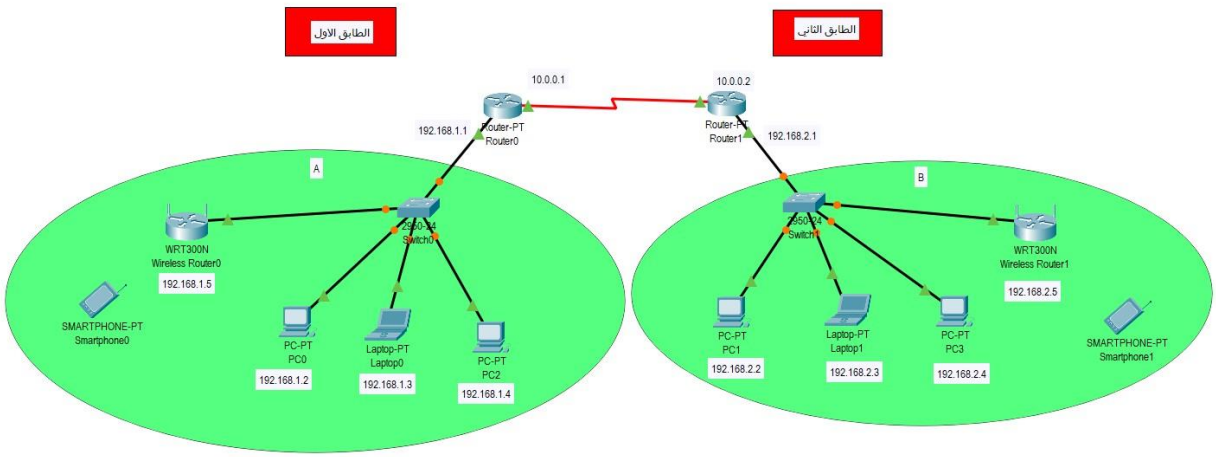

Figure 3.6. Connecting the network between two floors

In the local network connection, a cable of type (Copper Straight-Through) was used to connect the devices, and a Class C IP address was given, and an IP address of any type could be given.

In the first network with an address (192.168.1.1) for the router port and for the computers, IP addresses of the same type are distributed, but only with the last number differing.

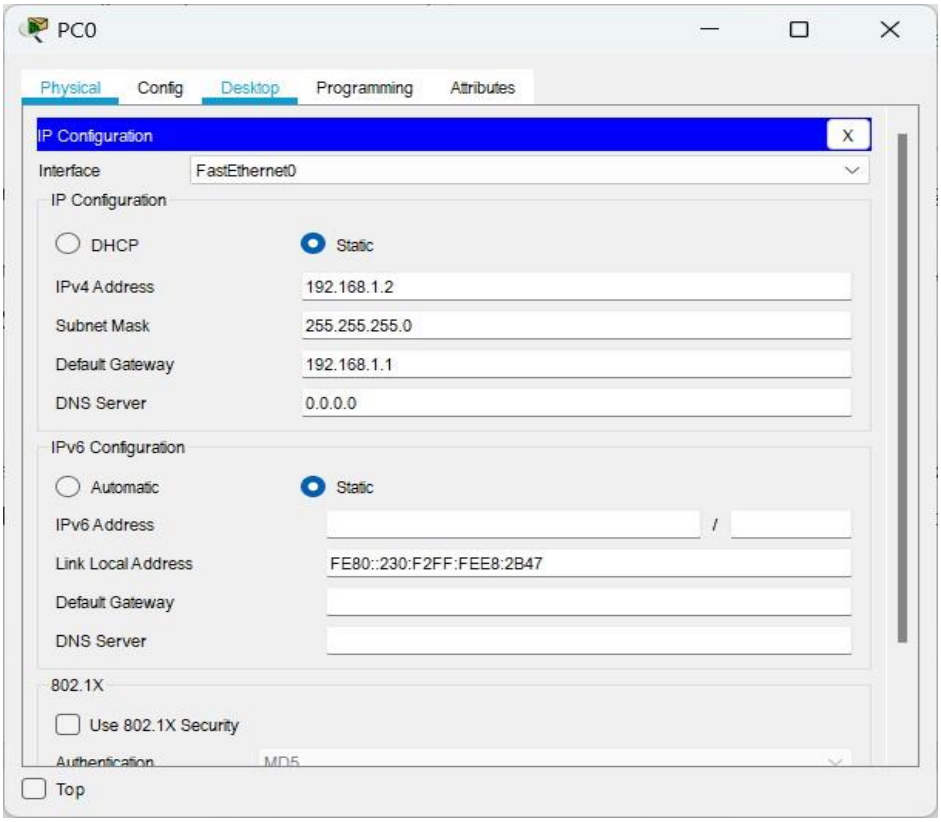

Figure 3.7. IP computer network 1

We also installed a wireless router and gave it a different IP address. We installed a phone and gave the password (12345678) and the network name (A) so they would connect to each other without interference.

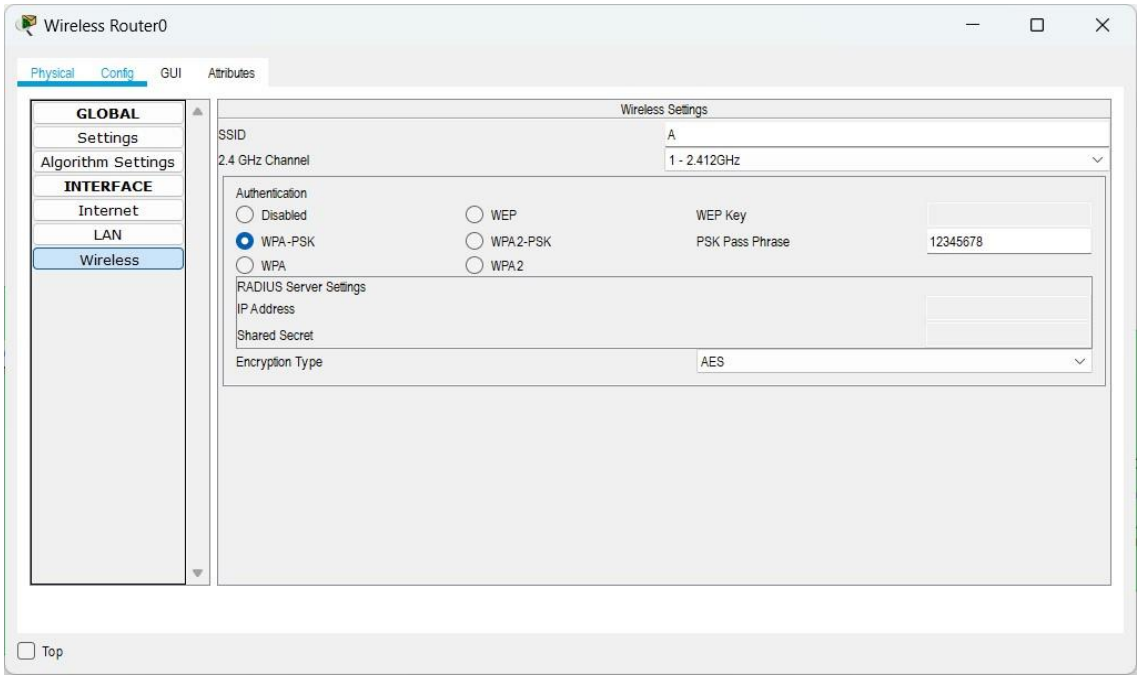

Figure 3.8. password and network name

In the second network, we also used Class C, but we change the third number to change the network, for example (192.168.2.1), and the IP Address is distributed to the rest of the devices, but also with the last number different, so that there is no conflict in the addresses.

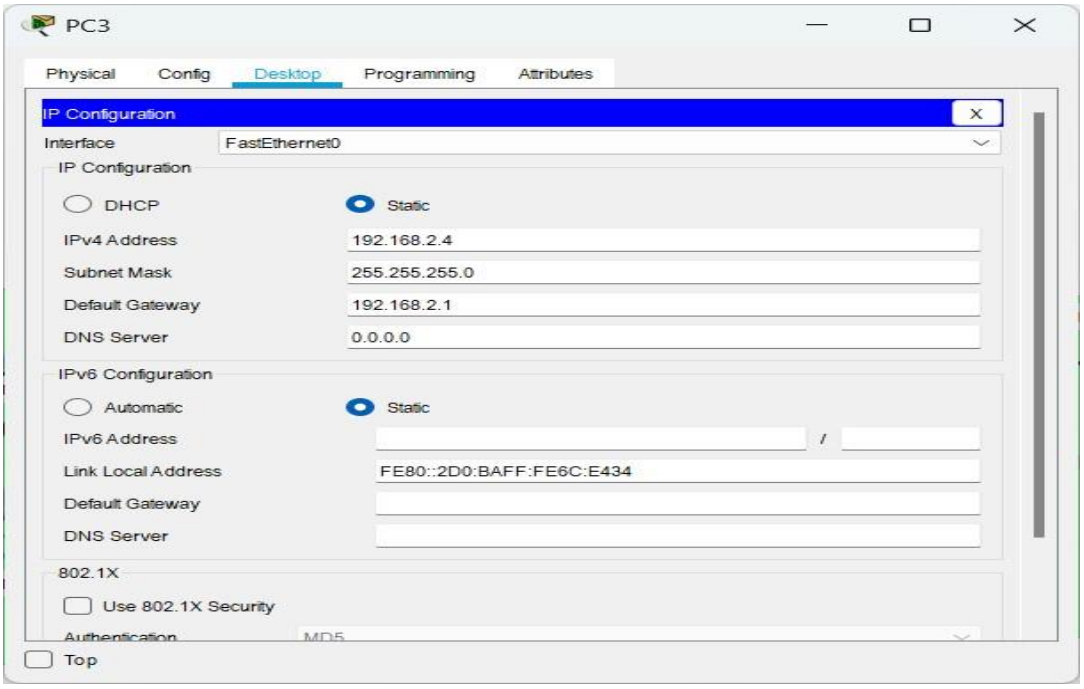

Figure 3.9. IP computer network 2

A wireless router and a mobile phone were placed, and the password (12345678) and the network name (B) were given. To contact each other

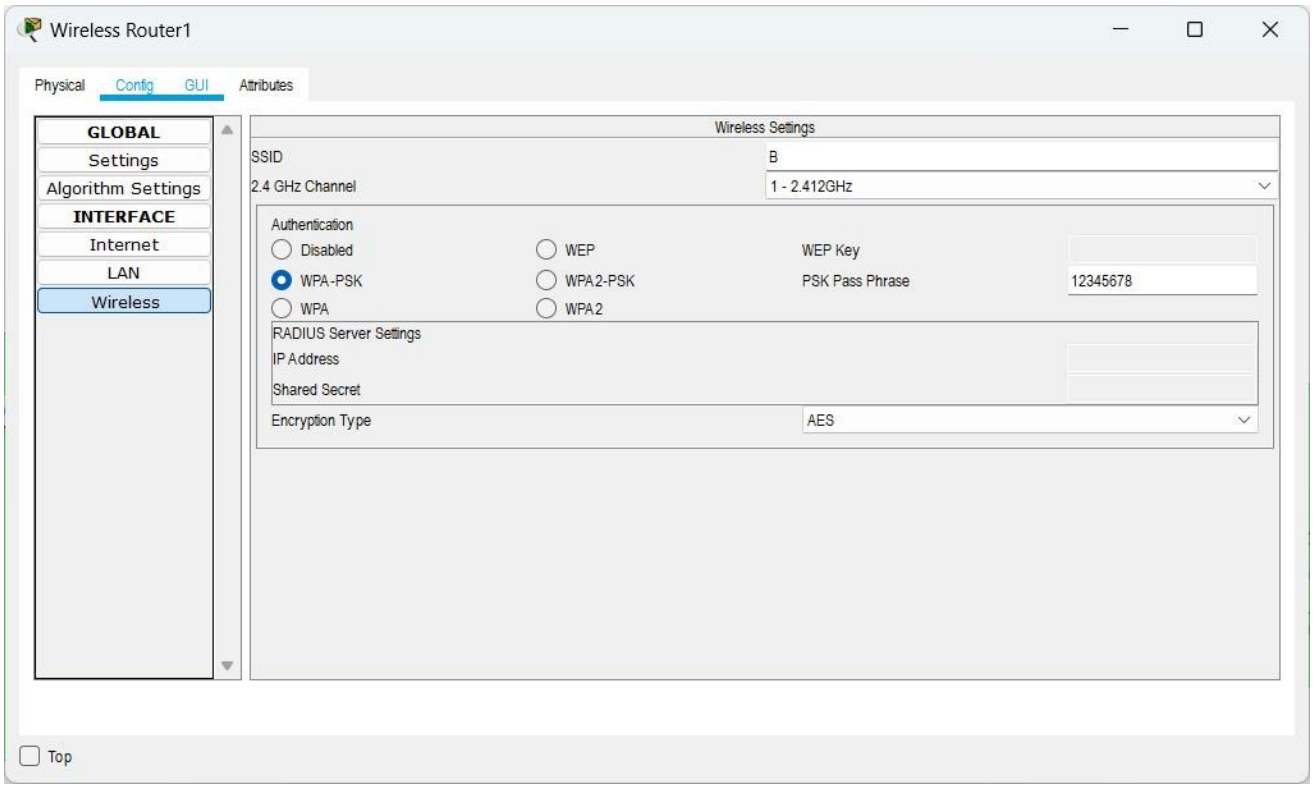

Figure 3.10. password and network name

3.2. Configuration Router:

Static Route configuration is one of the two ways of building the routing table. Static routing entails adding the network addresses leading to other devices to a router so that it can use them to find the best path for forwarding the packet.

There are two major ways in which static route configuration can be implemented: through the Command Line Interface (CLI) or through the Graphic User Interface (GUI).

3.2.1.What is Next Hop In static Routing?

The next hop is the next network device that a packet is forwarded to as it leaves a router.

When a router receives a packet, it examines the destination IP address and then looks up its routing table to figure out which interface it should forward the packet away from so that it gets to its destination faster.

3.2.3.How do you determine the Next Hop IP and Network IP in static routing?

To determine the Next Hop IP address to use in your configuration, you need to consider the two devices you are trying to establish connectivity between.

For instance, if you want to establish connectivity between two PCs in a network, you need to consider the shortest path between them. The routers you will be configuring to establish connectivity are those that appear along this path.

Let's say we want to configure the static route between two PCs having two routers between them. The next Hop IP address of the router at the left is the IP address of the interface that the right-hand side router is using to connect to the left-side router.

Similarly, the network IP address is the interface network address that the right-hand side router is using to connect to the right-hand PC (or another router if the path were to comprise more than two routers).

Step 1: Assign IP address to the routers and host devices

The first step is to assign IP address to the routers and host devices in the network, The network topology and the IP address you can use is shown below;

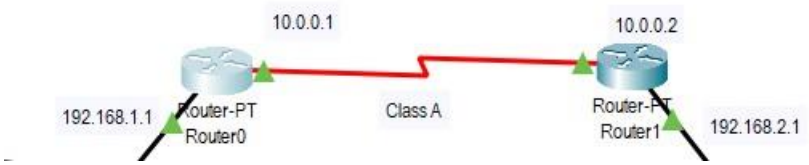

Figure 3.11. routers connect

Network Topology table

device	interface	Ip address	Network address
Router 1	Fa 0/3	192.168.1.1	192.168.1.0
	Se 2/0	10.0.0.1	10.0.0.1
Router 1	Fa 0/3	192.168.2.1	192.168.2.0
	Se 2/0	10.0.0.2	10.0.0.2

Step 2: Add the Next hop IP and Network IP to Router 1

Tap on the first router to open its GUI interface, then enter the following information consecutively. After that close the window.

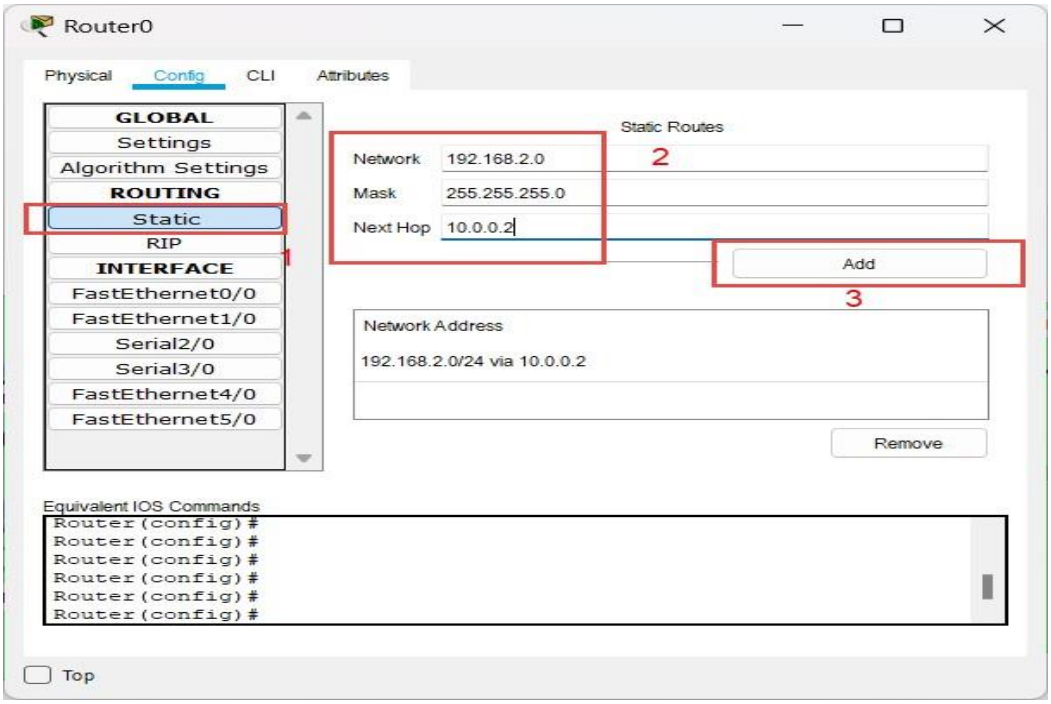

Figure 3.12. routers 1 static information

Step 3: Add the Next hop IP and Network IP to Router 2

Tap on the first router to open its GUI interface, then enter the following information consecutively. After that close the window.

On the second router, we do the same steps, but we enter the information for the first router, as shown in the figure:

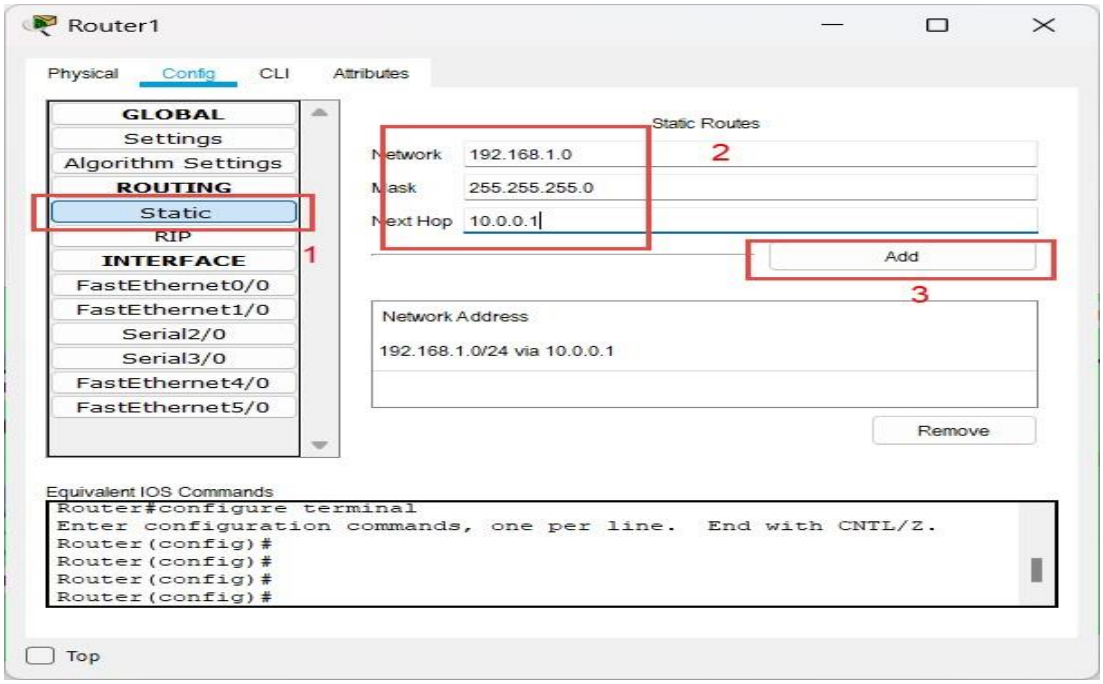

Figure 3.13. routers 2 static information

Through this process, the networks were connected, and information was sent and received from both parties without any interference or interference

Chapter Four

Conclusion and Future Work

4.1 Conclusion

Nowadays, LAN has become of great importance in our lives. This network is used in many fields such as education, health, industries, agriculture and infrastructure. In order to learn and understand how this network works, many practical learning tools are used. The aim of the research is to provide a local network simulation and tuning tool, where the student can simulate, build and manage systems in order to better understand the philosophy behind Internet networks.

The tool used is Cisco Packet Tracer which is a software developed by Cisco that is used to create and simulate a virtual network, which is basically a wireless network, without the need for any network hardware. The tool is free and suitable for working with almost all devices and operating systems. Cisco Packet Tracer allows users to gain a working knowledge of networking technology. In this project, "Cisco Packet Tracer" is used to design a local area network system for a home or factory with limited distance

We faced difficulty at the beginning because the Cisco program needs to learn the basics of work and build networks that work well. After reading and researching, we were able to collect ample information about this program and work well. The project was successfully linked and we also benefited from it in terms of study and work.

4.2. Future Work:

1. Adding many devices and many sensors to perform several additional tasks
2. Download the program with a newer version because it contains additional hardware
3. Building and controlling large networks
4. Connecting other types of networks, not limited to a specific type, to obtain more information

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