Higher Nationals

Internal verification of assessment decisions – BTEC (RQF)

INTERNAL VERIFICATION – ASSESSMENT DECISIONS			
Programme title	BTEC Higher National Diploma in Computing		
Assessor		**Internal Verifier**	
Unit(s)	Unit 02: Networking		
Assignment title	LAN Design & Implementation for SYNTAX SOLUTIONS		
Student's name	K.A Bhashitha Maduwantha		
List which assessment criteria the Assessor has awarded.	**Pass**	**Merit**	**Distinction**

INTERNAL VERIFIER CHECKLIST		
Do the assessment criteria awarded match those shown in the assignment brief?	Y/N	
Is the Pass/Merit/Distinction grade awarded justified by the assessor's comments on the student work?	Y/N	
Has the work been assessed accurately?	Y/N	
Is the feedback to the student: Give details: • Constructive? • Linked to relevant assessment criteria? • Identifying opportunities for improved performance? • Agreeing actions?	Y/N Y/N Y/N Y/N	
Does the assessment decision need amending?	Y/N	
Assessor signature		**Date**

Internal Verifier signature		**Date**	
Programme Leader signature (if required)		**Date**	
Confirm action completed			
Remedial action taken Give details:			
Assessor signature		**Date**	
Internal Verifier signature		**Date**	
Programme Leader signature (if required)		**Date**	

Higher Nationals - Summative Assignment Feedback Form

Student Name/ID	
Unit Title	Unit 02: Networking
Assignment Number	1

Assignment Number	1	Assessor	
Submission Date		Date Received 1st submission	
Re-submission Date		Date Received 2nd submission	

Assessor Feedback:

LO1 Examine networking principles and their protocols.

Pass, Merit & Distinction P1 P2 ☐ ☐
Descripts

M1 ☐

LO2 Explain networking devices and operations.

Pass, Merit & Distinction P3 P4 ☐   ☐
Descripts

M2 ☐   D1 ☐

LO3 Design efficient networked systems.

Pass, Merit & Distinction P5 P6 ☐   ☐
Descripts

M3 ☐   D2 ☐

LO4 Implement and diagnose networked systems.

Pass, Merit & Distinction P7 P8 ☐   ☐
Descripts

M4 ☐   D3 ☐

Grade:	Assessor Signature:	Date:
Resubmission Feedback:		
Grade:	Assessor Signature:	Date:

Assignment Feedback

Formative Feedback: Assessor to Student

Action Plan

Summative feedback

Feedback: Student to Assessor

Assessor signature		Date	
Student signature		Date	

Pearson Higher Nationals in

Computing

Unit 02: Networking   Assignment 01

General Guidelines

1. A Cover page or title page – You should always attach a title page to your assignment. Use previous page as your cover sheet and make sure all the details are accurately filled.
2. Attach this brief as the first section of your assignment.
3. All the assignments should be prepared using a word processing software.
4. All the assignments should be printed on A4 sized papers. Use single side printing.
5. Allow 1" for top, bottom , right margins and 1.25" for the left margin of each page.

Word Processing Rules

1. The font size should be **12** point, and should be in the style of **Time New Roman**.
2. **Use 1.5 line spacing**. Left justify all paragraphs.
3. Ensure that all the headings are consistent in terms of the font size and font style.
4. Use **footer function in the word processor to insert Your Name, Subject, Assignment No, and Page Number on each pag**e. This is useful if individual sheets become detached for any reason.
5. Use word processing application spell check and grammar check function to help editing your assignment.

Important Points:

1. It is strictly prohibited to use textboxes to add texts in the assignments, except for the compulsory information. eg: Figures, tables of comparison etc. Adding text boxes in the body except for the before mentioned compulsory information will result in rejection of your work.
2. Avoid using page borders in your assignment body.
3. Carefully check the hand in date and the instructions given in the assignment. Late submissions will not be accepted.
4. Ensure that you give yourself enough time to complete the assignment by the due date.
5. Excuses of any nature will not be accepted for failure to hand in the work on time.
6. You must take responsibility for managing your own time effectively.
7. If you are unable to hand in your assignment on time and have valid reasons such as illness, you may apply (in writing) for an extension.
8. Failure to achieve at least PASS criteria will result in a REFERRAL grade .
9. Non-submission of work without valid reasons will lead to an automatic RE FERRAL. You will then be asked to complete an alternative assignment.

10. If you use other people's work or ideas in your assignment, reference them properly using HARVARD referencing system to avoid plagiarism. You have to provide both in-text citation and a reference list.

11. If you are proven to be guilty of plagiarism or any academic misconduct, your grade could be reduced to A REFERRAL or at worst you could be expelled from the course

Student Declaration

I hereby, declare that I know what plagiarism entails, namely to use another's work and to present it as my own without attributing the sources in the correct form. I further understand what it means to copy another's work.

1. I know that plagiarism is a punishable offence because it constitutes theft.

2. I understand the plagiarism and copying policy of Pearson UK.

3. I know what the consequences will be if I plagiarise or copy another's work in any of the assignments for this program.

4. I declare therefore that all work presented by me for every aspect of my program, will be my own, and where I have made use of another's work, I will attribute the source in the correct way.

5. I acknowledge that the attachment of this document signed or not, constitutes a binding agreement between myself and Pearson, UK.

6. I understand that my assignment will not be considered as submitted if this document is not attached to the assignment.

Student's Signature: **Date:**
(*Provide E-mail ID*)   (*Provide Submission Date*)

Higher National Diploma in Computing

Assignment Brief

Student Name /ID Number	K.A Bhashitha Maduwantha
Unit Number and Title	**Unit 2: Networking**
Academic Year	2021/22
Unit Tutor	Mr.Chathuka Mallikarachchi
Assignment Title	**LAN Design & Implementation for SYNTAX SOLUTIONS**
Issue Date	04/09/2022
Submission Date	31/10/2022
IV Name & Date	

Submission format
The submission should be in the form of an individual report written in a concise, formal business style using single spacing and font size 12. You are required to make use of headings, paragraphs and subsections as appropriate, and all work must be supported with research and referenced using Harvard referencing system. Please also provide an end list of references using the Harvard referencing system. **The recommended word count is 3,000–3,500 words for the report excluding annexures, although you will not be penalised for exceeding the total word limit.**

Unit Learning Outcomes:

	LO1 Examine networking principles and their protocols.
	LO2 Explain networking devices and operations.
	LO3 Design efficient networked systems.
	LO4 Implement and diagnose networked systems.
	Assignment Brief and Guidance:

Scenario

SYNTAX SOLUTIONS is a privately owned, well-known Software company located in Colombo. The Management of **SYNTAX SOLUTIONS** has purchased a 3-story building in the heart of **Matara**. They are planning to make it one of the state-of-the-art companies in Matara with the latest facilities.

It is expected to have nearly **150 employees** in Matara branch.

Department	Number of Users
Customer Care	10
Sales and Marketing	20
Finance	25
Legal	5
HR	10
Developers	55
Network Team	5
Server Room	Servers +ISP connections

Following requirements are given by the Management.

- All the departments **must be separated** with **unique subnet** and should not communicate with each other **unless there is a special requirement**.

- **192.168.10.0/24** is given and should be used for all the departments except the server room. IPs should assign **using DHCP**.

- **ERP and CRM Systems** need to be implemented in Matara branch in local servers.

- **Number of servers required for the Server room** need to be decided by the

Network designer and should be assigned with **10.254.1.0/24** subnet. (Uses **static**

IPs)

- **High level of redundancy** is expected in network design to eliminate single point of failures and traffic bottle necks.

- **Sales and Marketing** Team need to access Network resources **using WIFI** connectivity.

- **Proper methods** for **networking monitoring** and **troubleshooting** need to be established.

- All possible **network security** mechanisms should be implemented.

Assume you have been appointed as the new network consultant of **SYNTAX SOLUTIONS**. Prepare a network architectural design and implement it with your suggestions and recommendations to meet the company requirements.

(Note: Clearly state your assumptions. You are allowed to design the network according to your assumptions, but main requirements should not be violated)

Activity 01

- Discuss the benefits and constraints of different network system types that can be implemented in the Matara branch and the main IEEE Ethernet standards that can be used in above LAN and WLAN design.

- Discuss the importance and impact of network topologies and network protocol suites while comparing the main network topologies and network protocol suites that are used in network design using examples. Recommend suitable network topologies and network protocol suites for above scenario and justify your answer with valid points.

Activity 02

- Discuss the operating principles of network devices (Ex: Router, Switch, Etc.) and server types that can be used for above scenario while exploring different servers that are available in today's market with their specifications . Recommend server/servers for the above scenario and justify your selection with valid points .

- Discuss the inter-dependence of workstation hardware with networking software and provide examples for networking software that can be used in above network design.

Activity 03

- Prepare a written network design plan to meet the above mentioned user requirements including a blueprint drawn using a modeling tool. (Ex: Microsoft Visio, EdrawMax).
  Support your answer by providing the VLAN and IP subnetting scheme for the above scenario and the list of devices, network components and software used t o design the network for above scenario and while justifying your selections.

- Test and evaluate the proposed design to meet the requirements and analyse user feedback by using a User feedback form.

- Install and configure Network services, devices and applications (Ex: VLAN,DHCP, DNS,Proxy, Web, Etc.) according to the proposed design to accomplish the user requirements and design a detailed Maintenance schedule for above Network.

*Note: - Screen shots of Configuration scripts should be presented.

Activity 04

- Implement a networked system based on your prepared design with valid evidence s and recommend potential future enhancements for the networked system with valid justifications to your recommendations. Use critical reflection to critically evaluate the design, plan, configuration, and testing of your network while justifying with valid conclusions.

-
  Develop test cases and conduct verification (Ex: Ping, extended ping, trace route, telnet, SSH, etc.) to test the above Network and analyse the test results against the expected results.

Grading Rubric

Grading Criteria	Achieved	Feedback
LO1 : Examine networking principles and their protocols.		
P1 Discuss the benefits and constraints of different network types and standards.		
P2 Explain the impact of network topology, communication and bandwidth requirements.		
M1 Compare common networking principles and how protocols enable the effectiveness of networked systems.		
LO2 : Explain networking devices and operations		
P3 Discuss the operating principles of networking devices and server types.		

P4 Discuss the inter-dependence of workstation hardware with relevant networking software.		
M2 Explore a range of server types and justify the selection of a server, considering a given scenario regarding cost and performance optimization.		
LO 1 & LO2		
D1 Critically evaluate the topology protocol selected for a given scenario to demonstrate the efficient utilisation of a networking system.		
LO3 : Design efficient networked systems		
P5 Design a networked system to meet a given specification.		
P6 Test and evaluate the design to meet the requirements and analyze user feedback.		

M3		
Install and configure network services and applications on your choice.		
D2 Design a maintenance schedule to support the networked system.		
LO4 : Implement and diagnose networked systems		
P7 Implement a networked system based on a prepared design.		
P8 Document and analyze test results against expected results.		
M4 Recommend potential enhancements for the networked systems.		

D3 Use critical reflection to evaluate own work and justify valid conclusions.		

SYNTAX SOLUTIONS Network Architectural Design

Acknowledgement

My lecturer, Mr. Chathuka Mallikarachchi, and our head, Mr. Geeth Weerasinghe, both of whom gave me the fantastic opportunity to complete this wonderful assignment on the topic of networks and who also assisted me in conducting extensive research that allowed me to learn a great deal of new information, deserve a special word of gratitude. I am truly grateful to them.

Second, I'd want to thank my parents and friends who greatly contributed to the completion of this project within the allotted time.

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Network

When you get a new computer, you'll likely attempt to connect to the Internet right away. To accomplish this, you connect to your router, which downloads the data from the Internet and then sends it on to the computer. This is the easiest way.

A network in information technology is described as a physical or wireless connection between at least two computer systems. A combination of two computers connected by a cable forms the simplest network. Peer-to-peer networks are this kind of network. We will describe more details about these networks in later. Both participants in this network have equal privileges; there is no hierarchy. Each computer has access to the other's data and can share resources like storage space, software, or peripherals.

Today's networks frequently include more than two computers and are a little more complicated.
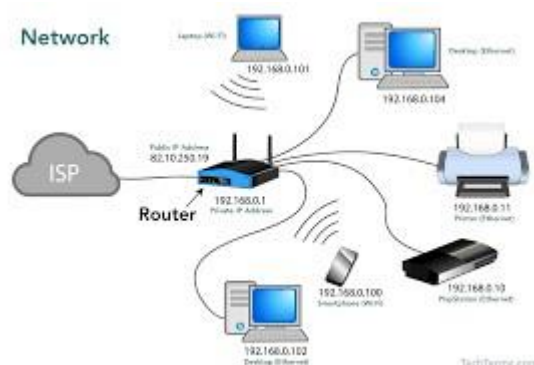
Figure 1-Network

Above Paragraph describe about the network. So, let's make a move to know about the networking. What is networking?

Networking is that exchange of information and ideas among people with a common profession or special interest, usually in an informal social setting. Making new friends, industry contacts, and even commercial partners is the goal of networking.

Advantages and disadvantages of Computer Network

Here we can point out the advantages as well as the disadvantages. Let's check this from the table below.

Table 1- Advantages and Disadvantages of computer Network

Advantages	Disadvantages
• Anyone can connect to a computer network	• Lacks independence
• Faster problem solving	• Lacks robustness
• Reliability	• Virus and Malware
• Highly Flexible	• Cost of the Network
• Boosts storage capacity	• Need an efficient handler
• Multitasking capability	• Health issues
• Ease of accessibility	• Implementation issues
• Enhance visibility	• Increased risk of hacking

Types of computer networks

There are mainly three types of computer networks based on their size: Those

are,

- Local Area Network (LAN)
- Metropolitan Area Network (MAN)
- Wide area network (WAN)

Apart from those we can see many other network types. The most common types of networks

are LANs and WANs.

Examples for other network types are,

- Personal Area Network (PAN)
- Wireless Local Area Network (WLAN)
- Campus Area Network (CAN)
- Storage Area Network (SAN)
- System-Area Network (SAN)
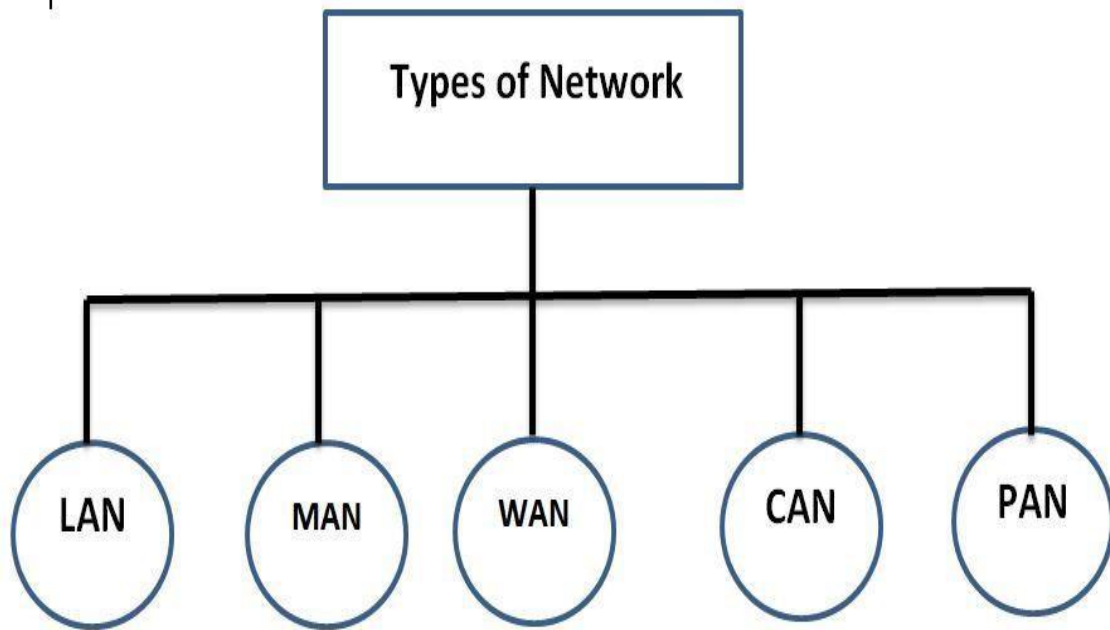- Virtual private Network (VPN)

Figure 2-Types of Network

Local Area Network (LAN)

The term "local area network" (LAN) refers to a collection of computers and related peripherals that connect wirelessly or through a common communications line to a server located within a specific geographical region. As few as two or three users at a home office may be connected to a local area network, while thousands of users may be connected to one in the central office of a company. Homeowners and IT administrators set up local area networks (LANs) so that network nodes may connect and share resources like printers or network storage. In addition to devices that can connect to and communicate using Ethernet, LAN networking also requires Layer 2 switches and Ethernet connections. For the purpose of streamlining traffic flows, larger LANs frequently have Layer 3 switches or routers.

A twisted-pair Ethernet cable must be used by the administrator to connect the end device to a LAN switch in order to set up a straightforward wired LAN. The same physical LAN or VLAN can be used by the devices to communicate after they are joined.

Here are some advantages and disadvantages of LAN Network

Table 2- Advantages and Disadvantages of LAN Network

Advantages	Disadvantages

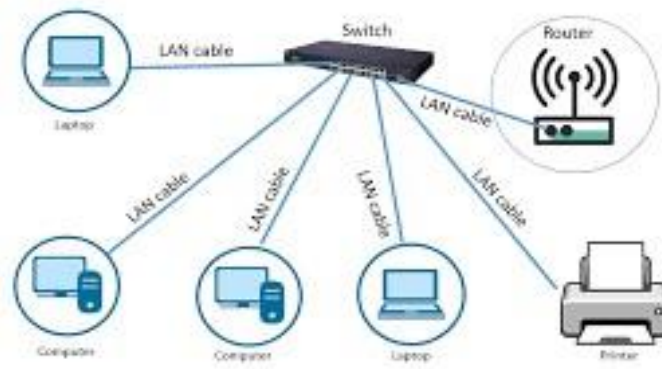|	
• Easy and fast communication	• Long-distance major limitation
• Simple and relatively inexpensive	• Installing a LAN is difficult and expensive
• Data protection	
• Collaboration of resources	• Data Sharing via Outside Sources
• Users can access the same files	• High degree of maintenance

Figure 3- LAN

Wide area network (WAN)

A Network that spans a huge geographic region, such as an entire country, continent, or even the globe. Allows for long distance data or information communication. The major telecommunication companies often provide physical connectivity for WANs. WAN data can be sent in a variety of ways, each with advantages, disadvantages, and prices.

Leasing data lines is used to build a private WAN. To ensure a constant connection between the network endpoints, the service provider maintains the network. Leased lines offer symmetric upload and download speeds that are constant. It is typically the most expensive choice because the service provider reserves specific infrastructure for a private WAN. Planning for redundancy is required since service interruptions are likely to occur if there is damage at any point in the link.

Here are some advantages and disadvantages of WAN Network.

Table 3- Advantages and Disadvantages of WAN Network

Advantages	Disadvantages

• Easy of communication	• complected and
• Boost your privacy	• complex slow in speed
• Share information over the large area	• Security problem
• Large network cover	• Maintenance problem
• Increases Bandwidth	• Require high-performance device
• Guaranteed uptime	• Training cost
•	• Can be expensive to hire a WAN
	•

Figure 4- WAN

Metropolitan area network (MAN)

A metropolitan area network (MAN) is a type of computer network that links computers in a region with numerous buildings, such as one or more large cities, or any other area with several structures. Local area networks (LANs) are smaller than MANs, which are larger than LANs (WAN). Most MANs connect LANs together using fiber optic lines. Customers with high-capacity needs in a metropolitan area are the main users of metropolitan area networks. Due to their extensive zone coverage, MANs are occasionally referred to as broad zone systems. However, a MAN is a single system as opposed to a network of interconnected systems, which is what a WAN is.

Here are some advantages and disadvantages of MAN Network

Table 4- Advantages and Disadvantages of Man Network

Advantages	Disadvantages

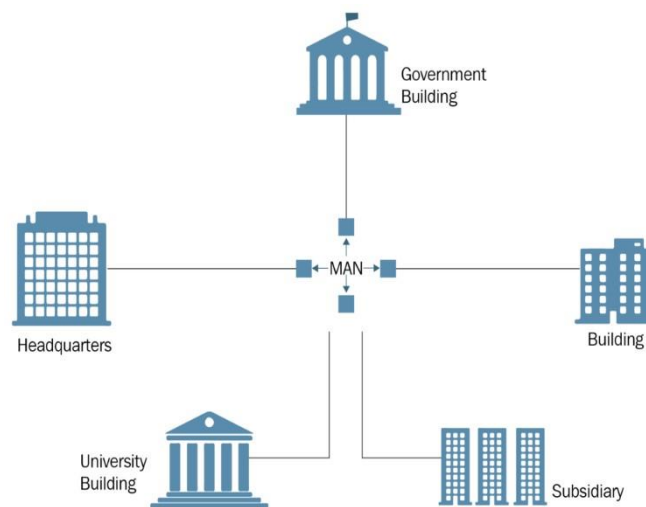|	
• Increases data handling efficiency • Increases the rate of data transfer • Offers a strong backbone for a large network and improved WAN access. • A MAN typically spans several city blocks or the entire city. • provides higher security compare to WAN	• compared to LAN, the data rate is minimal. • Making a system secure against hackers is challenging managing the extensive network is challenging • Once the network grows huge, it becomes tough to safeguard it

Figure 5-MAN

Differences in the three networks WAN, LAN, MAN

Table 5- WAN, LAN, MAN

LAN	WAN	MAN
Stands for local area network	Stands for metropolitan area network	Stands for wide area network
Ownership is private	not be owned by one organization	ownership can be private or public
Less congestion in LAN	More congestion than MAN in WAN	More congestion in MAN
Maintenance are easy	Maintenance is also difficult than LAN as well MAN	Maintenance is difficult than LAN

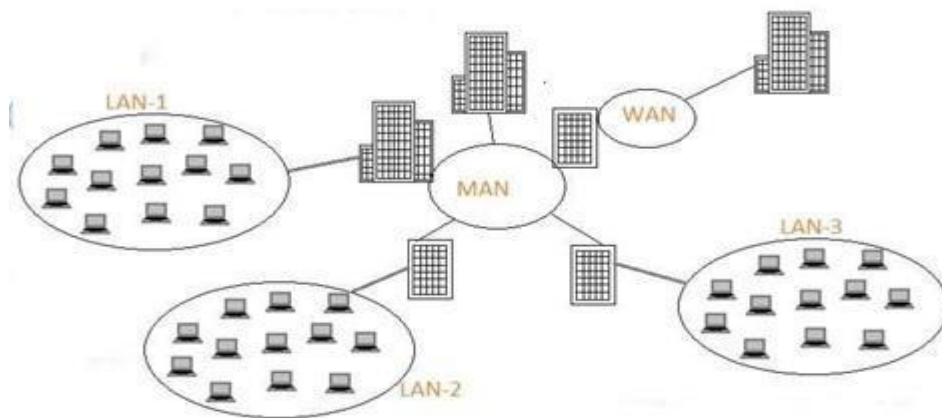| Transmission speed is high	Transmission speed is low	Transmission speed is average
Spans a zone between 1 and 10 km	Covers a vast region that extends past 100km	Covers an area with in 100km
A network in a home, school or an office	A network covering a state or a country	A network in a small town

(*Difference between lan, man and wan* 2021)

Figure 6-LAN, MAN, WAN

Here is a brief description about the other network types

Personal area network (PAN)

A personal area network (PAN) links technological items that are normally within a single user's range, which is roughly 10 meters (33 feet) apart. Laptops, smartphones, tablets, wearable technology, printers, and entertainment equipment are the most common PAN components. Personal area networks can be wireless, like Bluetooth, or wired, like a printer attached to a personal computer. WPAN stands for wireless personal area network.

Figure 7- PAN

Virtual Private Network (VPN)

Through the use of a virtual private network (VPN), a secure and encrypted connection can be established over a less secure network, such the internet. When used for business, a VPN restricts Internet access to the organization's data to only authorized people. An organization with numerous offices can share data with all of its staff members, regardless of location, with the aid of a VPN. SSL VPN, Site to Site VPN, Client to Server VPN are some examples for type of VPNs.
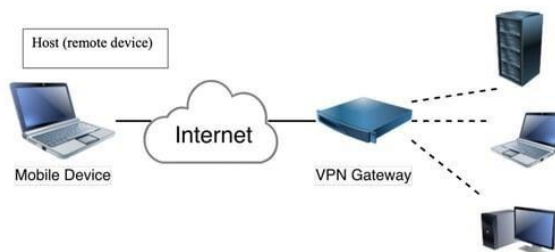
Figure 8- VPN

Wireless local area network (WLAN)

A collection of collocated computers or other devices that form a network based on radio broadcasts rather than wired connections is known as a wireless local-area network (WLAN). WLAN uses radio waves to transport data. Packages of data are sent.
In comparison to a physical network, a WLAN is more porous. A bad actor using a wired network would need to physically enter the network or breach an external firewall. A malicious user only has to be in the network's coverage area to access a WLAN. The ability of devices to connect wirelessly, doing away with the need for wires, is the WLAN's most evident benefit. As a result, local networks can be built in houses and businesses without Ethernet cable in the structure. By adding one or more repeaters, a WLAN's range can be readily increased.

Compared to wired networks, wireless networks are inherently less secure. If security is a concern, it is crucial to restrict access to the network because any wireless device can seek

to join to a WLAN. Wireless networks are also more vulnerable to signal interference from other sources and physical obstructions like concrete walls.

Figure 9- WLAN

Recommendation

I used a branch of a MAN network for this Matara project (Metropolitan Area Network). Network cities and school districts are examples of big geographic areas that are part of the metropolitan area. As a result, Colombo was home to the renowned software business. This calls for merging the Matara branch's network structure with the Colombo corporation. Consequently, the metropolitan area network is advantageous for this business.

Standards

In practically every corporate and public service body, standards are required. Standards are mostly used to make sure that hardware and software created by various suppliers can cooperate. Without networking standards, creating networks with simple information sharing would be challenging, if not impossible. Standards aid in the creation and maintenance of free markets and enable vendors to compete on the basis of the quality of their goods while remaining compatible with those already on the market.

Here are some noted standards organizations in networking

- International Standards Organization (ISO)
- International Telecommunication Union (ITU)
- Institute of Electronics and Electrical Engineers (IEEE)
- American National Standards Institute (ANSI)
- Internet Research Task Force (IETF)

- Electronic Industries Association (EIA)

(*Study.com*)

Institute of Electronics and Electrical Engineers (IEEE)

An association called the Institute of Electrical and Electronics Engineers creates standards for the computer and electronics industries. Numerous researchers, engineers, and students from throughout the world make up IEEE. The primary AIM of IEEE is to promote excellence and innovation in technology for the benefit of humanity. The Internet and its related technologies must adhere to a set of rules and best practices in order for all networking devices to function properly and for communication between diverse devices to be guaranteed by the IEEE standards for computer networks.

The IEEE's computer society launched Project 802 in 1985 to facilitate uniform communication across various devices due to the diversity of computer system manufacturers. The IEEE 802 wireless standards are the designation for the computer networking specifications. The data link layer and physical layer technologies, such as ethernet and wireless communications, are covered under the IEEE 802 set of networking standards.

The data link layer was separated by IEEE into two components, namely,

- LLC or Logical Link Control
- MAC or media Access Control

This table shows the IEEE standards in detailed

Table 6- IEEE Standards

Standard	Purpose
802.1	Internetworking
802.2	Logical Link Control
802.3	Ethernet LAN (CSMA/CD)
802.4	Token-Bus LAN
802.5	Token-Ring LAN
802.6	Metropolitan Area Network
802.7	Broadband Technical Advisory Group
802.8	Fiber-Optic Technical Advisory
802.9	Integrated Voice OR Data Network
802.10	Network Security
802.11	Wireless Networks
802.12	Demand Priority Access LAN
802.15	Wireless Personal Area Network
802.16	Broadband Wireless Metropolitan Area Networks
802.17	Resilient Packet Rings
802.20	Mobile Broadband Wireless Access

Ethernet

In a number of IEEE 802.3 standards, Ethernet is described. The physical and data-link layer requirements for Ethernet are specified in these standards. Here are some most important 802.3 standards,

- 10Base-T (IEEE 802.3)
- 100Base-TX (IEEE 802.3u)
- 100Base-FX (IEEE 802.3u)
- 1000Base-CX (IEEE 802.3z
- 1000Base-T (IEEE 802.3ab) (*What is ethernet? definition from searchnetworking*)

The 802.3 standard contains a large number of additions and modifications, and each is identified by letters that are concatenated after the number "3".

Wi-Fi

The 802.11 standard is outlined in many WLAN standards. It describes an over-the-air interaction between two wireless clients or between a wireless client and a base station. It is crucial that Wi-Fi has internationally accepted standards and specifications since it is used for so many different things and is built into a huge number of products created by many manufacturers. It is feasible to guarantee that technology created by different manufacturers will communicate satisfactorily by having standards that outline the precise operation of the technology.In 1997, the initial Wi-Fi standard was published without a suffix letter. But as more variations were made available, a suffix letter was added to identify the precise variety. It was written in lower case. The different IEEE 802.11 standards encompass everything, including the bearers and system components needed for interworking.

Table 7- Wifi Standard

Standard	Freq Band	Bandwidth	Modulation	Max Data Rate
802.11	2.4 GHz	20 MHz	DSSS,FHSS	2 Mbs
802.11b	2.4 GHz	20 MHz	DSSS	11 Mbs
802.11a	5.0 GHz	20 MHz	OFDM	55 Mbs
802.11g	2.4 GHz	20 MHz	DSSS,OFDM	55 Mbs
802.11n	2.4 GHz, 5.0 GHz	20 MHz,40 MHz	OFDM	600 Mbs
802.11ac	5.0 GHz	20 MHz,40 MHz, 80 MHz,160 MHz	OFDM	6.93 Gbs

Network Topologies

Network topology describes how different nodes, devices, and connections are logically or physically structured in relation to one another on your network. Logical and physical topologies are the two methods used. As implied by the name, physical network topology describes the actual wires, cables, and other physical connections that exist between nodes and the network. It refers to the conceptual knowledge of how and why the network is set up in the manner it is, as well as how data flows across it. Logical network topology is a little more abstract and strategic. To guarantee your network is effective and healthy, effective network administration and monitoring require a solid understanding of both the physical and logical topology of a network.

Depending on the size of the entire network and your goals, there are a variety of network topologies that are appropriate for various uses.

Network topology types

- Star Topology
- Bus Topology
- Ring Topology
- Tree Topology
- Mesh Topology
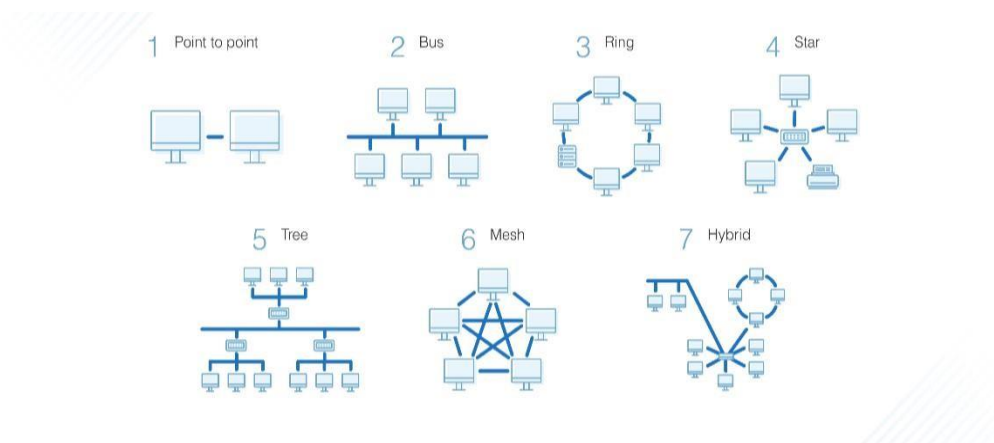- Hybrid Topology
- Point to point Topology

Figure 10-Topologies

Star Topology

A network architecture known as a star topology, also referred to as a star network, is one in which every device is connected to a central hub. It is by far the most common Network Topology and one of the most common setups for computer networks. Numerous star topology instances can be found in real-world settings, including airports, hospitals, banks, and educational institutions. Star topology has several applications in networking. Due to its low cost and easy availability, you can find its applications all around you.

Star topology's operation can be understood in a relatively straightforward manner. In this form of network structure, Nodes can only connect with one another through a central device that is part of the network; direct communication between Nodes is not possible.

Based on its mode of operation, star topology may be divided into three groups, which are as follows:

- Passive Star Topology
- Active Star Topology
- Star Topology Using Switch

Figure 11-Star Topology

Bus Topology

A primary run of wire with a terminator at each end makes up a bus topology. The linear cable connects all nodes, including workstations, printers, laptops, servers, etc. Signal bounce is avoided by using the terminator to absorb the signal as it reaches its finish. In 802.3 (ethernet) and 802.4 standard networks, the bus topology is primarily employed. Compared to other topologies, the configuration of a bus topology is a lot easier. Among bus topologies, CSMA is the most popular access technique.
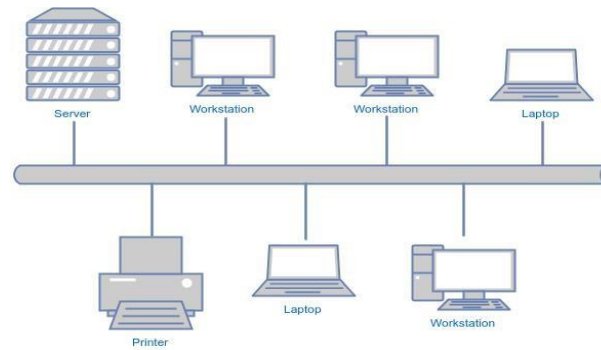
Figure 12- Bus Topology

Tree Topology

Each node in a tree topology is connected to the others in a hierarchical manner. A topological hierarchy has a minimum of three different levels. On workstations and databases in corporate networks, tree topologies are frequently utilized to organize data. By attaching a number of parts to the central node, a tree topology integrates numerous star topologies. You can use tree topology to create clusters at each point in your network when you have a multi-story building. For a small LAN, tree topology is actually an excellent solution.
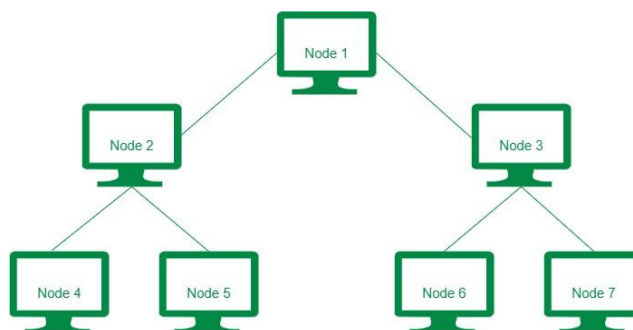
Figure 13-Tree Topology

Ring Topology

In a ring topology, devices are interconnected in a ring structure and communicate with one another based on the neighboring nodes of their ring node. LANs or WANs may employ this structure. The advantages of a ring topology include, it does not need a central hub in order to function. Since this ring topology allows for unidirectional data flow, the likelihood of data collision is quite low. Any new nodes can be easily added to a network with a ring topology, and topology management is made easier. Ring topology has the capacity to transmit data quickly.
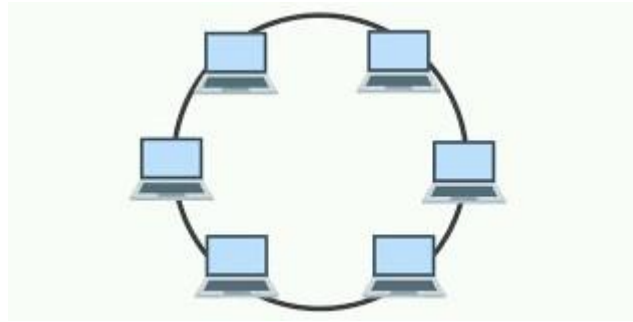
Figure 14-Ring Topology

Mesh Topology

A mesh network is a network where devices, also known as nodes, are connected to one another and branch off of other nodes. Mesh network topologies design numerous paths for data to transit between linked nodes. Each node in a complete mesh network topology has a direct connection to every other node. Only certain nodes in a partial mesh topology have direct connections to one another. Mesh networks convey messages using routing or flooding algorithms. Mesh networks can be utilized in both big businesses and small home networks. But they work better in bigger areas.
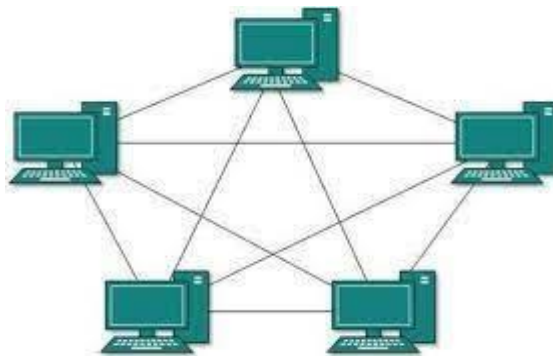
Figure 15-Mesh Topology

Hybrid Topology

A hybrid topology combines elements from two or more distinct networking topologies. It combines the mesh topology, ring topology, bus topology, and tree topology. Depending on the needs, there are several hybrid topologies that connect various fundamental topologies to create a new topology. The decision is affected by the quantity of machines, their location, and the desired network performance. There are several kinds of hybrid topologies that combine numerous fundamental topologies to create a new type of topology based on the needs.

   - Star-Ring Hybrid Topology

  □   Star-Bus Hybrid Topology

  □   Hierarchical Hybrid Topology
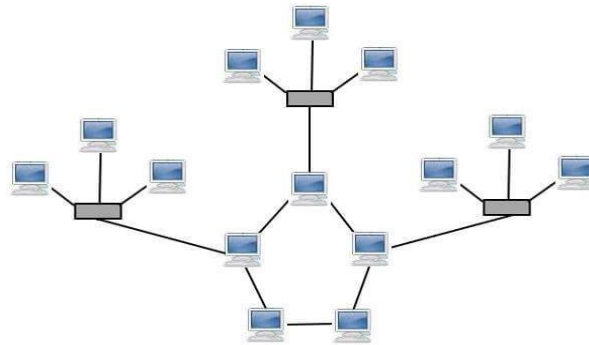
Figure 16- Hybrid Topology

(*Computer network topologies - javatpoint*)

Advantages and Disadvantages of main three Topologies

Table 8- Advantages and Disadvantages of main three Topologies

Topology	Advantages	Disadvantages

Star	• It is simple to add a second computer to the network. If one computer on the • network fails, the rest of the network continues to function normally robust in character •	• All computers are separated from the network and the network as a whole goes down if the hub, switch, or central computer malfunctions. • The need for additional hardware, like as hubs or switches, raises the price. • more cable is needed than with a linear bus.
Bus	• Topology is simple to understand. • By connecting the two connections, it is simple to extend. • When the network is small, it operates very effectively.	• In comparison to other topologies, this network topology is extremely sluggish. • High packet loss occurs. Large networks are not best • served by bus topology.
Ring	• Installing and growing it is inexpensive. least • collision. • Additional workstations can be added to the network in this configuration without degrading its performance.	• It is Pricey. • In terms of performance, it is inferior than the bus topology. • The entire network is affected if one workstation crashes, or the entire network is affected if one node fails.

Network Protocols

A protocol is a collection of guidelines used in networking to format and handle data. Like a universal language for computers, network protocols. Devices on either side of a communication exchange must accept and adhere to protocol norms for information to be

sent and received successfully. At every level of the network, protocols divide bigger processes into separate, well-defined jobs and functions.

There are various Internet protocols for various kinds of processes. In discussions on protocols, the OSI model layer to which they belong is frequently brought up.

OSI Model

Here is brief description about OSI Model.

An abstract illustration of how the Internet functions is provided by the Open Systems Interconnection (OSI) model. It has seven layers, each of which depicts a separate class of networking operations. Below are the seven layers.

- Application Layer
- Presentation Layer — Software layer
- Session Layer
- Transport Layer
- Network Layer
- Data Link Layer — Hardware Layer
- Physical Layer
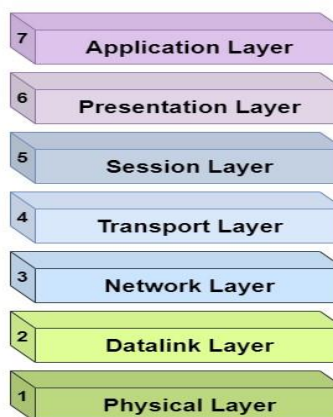
Figure 17- OSI Model

Here are some illustrations of the most popular network protocols.

Hypertext Transfer Protocol (HTTP)

The World Wide Web's data can be accessed using this protocol (www). Because of its effectiveness in a hypertext context where there are quick jumps from one document to another, this protocol is also known as the "Hypertext Transfer Protocol." Resources are transferred between client devices and servers via the internet using the HTTP protocol. The resources required to load a web page are requested by client devices from servers, which then respond to the requests by sending responses back to the client. ASCII code is used in requests and answers sent between servers and clients while exchanging data. The server responds with code that the client browser will interpret as a web page. Requests specify the information the client is looking for from the server.

HTTP has the ability to download plugins or extensions anytime an application needs more features, and it can then display the necessary information. All HTTP pages are saved in internet caches called "page caches" when a website is loaded for the first time. As a result, the material loads rapidly when the page is accessed again.

Figure 18- HTTP

Hypertext Transfer Protocol Secure (HTTPS)

It is an HTTP extension or version that is secure. This protocol is mostly employed to secure data transmissions between a website and a web browser. At the transport layer, this protocol functions. Compared to HTTP, HTTPS is slower in terms of speed. The data in HTTPS is shielded from outsiders or hackers by SSL technology. Additionally, the users of this technology grow to trust it. Also, the primary drawback of HTTPS is the requirement for users to obtain an SSL certificate.

File Transfer Protocol (FTP)

For the purpose of transferring files from one host to another, TCP/IP provides the standard internet protocol known as FTP. It is mostly used to transmit web page files from

the computer that created them to the computer that serves them to other computers connected to the internet. It is also used to download files from other servers to computers. A Web browser includes an integrated version of the FTP application. This GUI-based FTP client makes file transfers incredibly simple and eliminates the need to memorize FTP commands.

FTP has a lot of benefits, including speed. One of the quickest methods for transferring files from one computer to another is through FTP. You need not be concerned that you will lose progress if your file transmission is halted. If your connection is lost, FTP allows you to resume a broken file transfer. Even in the event of unforeseen circumstances, top FTP services ensure that data is never lost. With disaster recovery, frequent, automatic file backups are performed for you.

There are minor disadvantages as well as the advantages mentioned above. FTP is by nature an insecure method of data transfer. This protocol allows for the sharing of data, usernames, and passwords in plain text when sending files. Also, not all systems are compatible with FTP. When sending files over FTP, compliance should also be a concern. Your company may be subject to noncompliance fines if you use FTP on its own or with an unreliable FTP vendor.
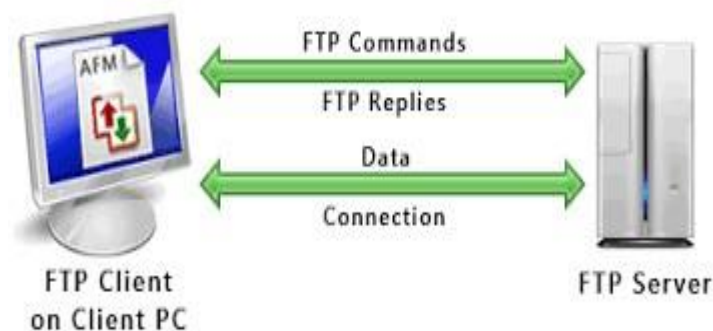
Figure 19- FTP

(*What is the network layer? | network vs. internet layer - cloudflare*)

Network Devices

The physical components that enable hardware on a computer network to connect and communicate with one another are referred to as network devices, sometimes known as networking hardware.

Here are examples for network devices,

- Bridge

- Switch
- Routers
- Gateway
- Repeater
- Hub

Bridge

The data link layer is where a bridge operates. A bridge is a repeater with the added capability of content filtering through the source and destination MAC addresses. Bridges facilitate communication between the nodes (devices) in multiple separate LANs that are connected by a common protocol. Bridges assist in expanding a single LAN's network capacity by connecting numerous LANs.

Figure 20- Bridge

Switch

A network switch establishes a connection between networked devices and enables them to "speak" by exchanging data packets. A network switch functions at OSI model's network layer 2. In modern world most switches used Ethernet. A four- or eight-port switch should be adequate for a small office or home office, however switches up to 128 ports are typically used for bigger deployments.

Figure 21- Switch

Routers

In the OSI model, routers are networking devices that operate at layer 3 or the network layer. The connected computer networks depend on them to receive, analyze, and forward data packets. Both LANs (Local Area Networks) and WANs can use routers (Wide Area Networks). Routers are produced by some well-known companies, such as Cisco, HP, Juniper. Here is the main type of routers

- Wireless Routers

- Broadband Routers
- Core Routers
- Edge Routers
- Brouters

Figure 22- Router

Hub

In essence, a hub is a multi-port repeater. A hub joins several wires that come from several branches, like the connector in a star topology that joins various stations. For all the devices connected through a hub, it serves as a centralized connection. Hubs are in three types.

Passive hub, Active Hub and Intelligent Hub. As applications of hub, we can say that it's used in small networks. Additionally, they are utilized in businesses to offer connectivity.

Repeater

Repeaters are at physical layer in OSI model. A repeater is a piece of technology that boosts the signal it receives. Prior to the signal becoming too weak or garbled to be broadcast for a further distance over the same network, it must regenerate the signal over that network. Signal boosters are another name for repeaters. In certain areas, where attenuation and signal loss are significant, repeater installation is essential.

Figure 23- Repeater

Servers in networking

A server is a computer program or apparatus that offers a service to a client, also known as another computer program, and its user. Services are the numerous functionalities that servers might offer. These services include executing computation for a client or distributing data or resources among many clients. Web servers, mail servers, print servers, file servers, database servers, application servers, and game servers are just a few examples of servers.

◉ Application Server

A contemporary type of platform middleware is an application server. It is system software that sits between the user's programs, the external resources, and the operating system (OS) on three sides. These servers don't have to be connected to the Internet. Web-enabled PCs serve as their clients. In accordance with the nature of the business application and the standards in the specific industry for which the application has been created, an application server also supports a variety of application design patterns.

◉ Web Server

Websites are hosted on these servers. A web server is software and hardware that responds to client requests made through the World Wide Web using HTTP and other protocols. Websites' domain names are used to access web server software, which makes sure that the content of the site is sent to the user who requests it. A single web server can also host many domains. You can deliver both static and dynamic content on a web server. Web servers, application servers, and databases are all components of dynamic web browsers.
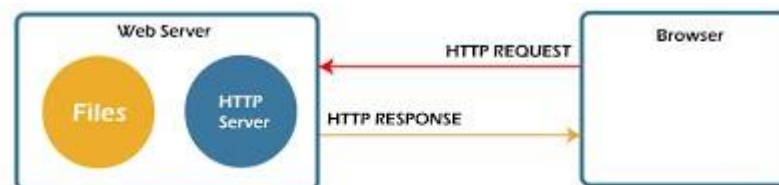
Figure 24- Web Server

◉ File Server

The central server in a computer network that is responsible for the storage and management of data files is called a File Server. Through a network, people can exchange information without physically moving any files. Users can gain from remote access in addition to local network access to the files. This involves allowing users to access and save the desired file while they are mobile. For accessing files online, FTP (File Transfer Protocol) and SFTP (Secure File

Transfer Protocol) are utilized. Server Message Block (SMB), Network File System (NFS), and File Transfer Protocol are a few of the file server protocols (FTP).

⭕ **Proxy Server**

A machine connected to the internet through the proxy server receives incoming client requests and sends them on to the target server. A proxy server serves two main purposes: to maintain the anonymity of the system it uses.

to utilize caching to accelerate resource access.

Proxy servers come in a variety of forms. The forward and reverse proxy server types are the two most popular varieties. Proxy server raises the user's level of privacy and security. Also, it conceals the user's identity (IP address).

Servers Availability in today's market

It is necessary to take increased RAM and storage capabilities into account when choosing a server for the aforementioned network. Here are some of the top servers available nowadays.

1.Dell PowerEdge

Figure 25- Dell PowerEdge

- CPU: Intel Xeon E-224G
- RAM: 8GB
- Storage: 1TB
- Front Audio Jack

2.HP ProLiant DL380 G6

Figure 26- HD ProLiant

- CPU: Intel Xeon X5570
- RAM: 4GB
- Storage: 16 SFF
- Dual Port Gigabit Server Adapter

3.Synology DiskStation

Figure 27- Synology

- CPU: Intel Celeron J3455
- RAM: 8GB
- Storage: 4 TB
- 2 USB 3.0 Ports

4.HPE ProLiant DL20 Gen10

Figure 28- HPE ProLiant

- CPU: Intel Xeon E-2236
- RAM: 8GB
- 2x 1Gbe embedded NIC

Server Manufacturing Companies

Servers are manufactured by some of the world's leading companies. A few years ago, several companies were involved in this, but nowadays the competition has increased due to the addition of many companies.

Although there are many competitors today, we can identify some major companies that have kept their name at the top of the field.

- Dell Technologies
- Hewlett Packard Enterprises
- IBM
- Inspur

- Lenovo group limited, are some of them.

One of the most well-known computer manufacturers in the world, Dell Technologies is well recognized for its premium gaming and business laptops. Hewlett-Packard Enterprise is the second-largest server company in the world, behind Dell, which holds more than 16% of the market. Inspur, Lenovo, and IBM are among the smaller but rapidly expanding group of server brands that follow HPE and Dell. The third-largest server market share belonged to Inspur with a total market share of 10.5% and sales of $2.53 billion. (*The 10 largest server companies in the world, and what they do* 2022)

Rank	Market Share
1	Dell Technologies — 17.2%
2	Hewlett Packard Enterprise 16.8%
3	Inspur — 10.1%
4	Lenovo Group Limited 6.2%
5	IBM — 5.3%
6	Huawei — 4.9%
7	Supermicro — 4.8%
8	Fujitsu — 3.1%
9	Sugon — 2.0%
10	H3C <1%

Figure 29- Server Manufacturing Companies

Critical Analyze of network software

A wide range of software is referred to as network software and is used for computer network design, implementation, operation, and monitoring. The establishment of intentbased networks is made possible by networking software and the software-defined networks (SDNs) it produces, which aid engineers in addressing these difficulties (IBNs) A key component of any networking system is network software. It assists network administrators and security staff in managing, monitoring, and better controlling network traffic as well as reducing network complexity.

Server Software

Software referred to as "server software" is created, run, and maintained on a computing server. It offers a variety of computer services and functions, and encourages the use of the server's processing capacity in doing so. It is uncommon to access a website from a server or to offer material from a desktop or laptop at home, but it is doable. Following are some server software types.

- Web server software
- Application server software
- Database server software
- File server software

Server OS

An operating system that is created specifically to be installed and utilized on a server computer is known as a server operating system (OS). Common server functions including Windows, file and database servers, Web servers, mail servers, application servers, and print servers are supported and made possible by server operating systems. Different server operating systems come in different varieties.

Ex: (Windows, Linux, Netware, MacOS)

Figure 30- Server OS

A brief introduction showing the similarities, dissimilarities, advantages and disadvantages of the above Server OS

- Windows is the most popular one among all these.
- Almost all software, drivers, and games run on Windows.
- You'll learn that Windows has so many features that you can accomplish practically anything quickly once you get to know it well.

- Your PC should have a high smash limit, plenty of hard drive space, and a good graphics card if you are installing Windows OS.

- Microsoft Windows is more dated than Apple's Macintosh OS. Being introduced a year before its Microsoft counterpart, it is the first successful graphical operating system ever.

- Viruses hardly ever affect Apple Macs. The greater market share of Window is primarily to blame for this.

- Macs are less prone to hardware and software crashes since they can only run on Apple machines.

- Even more expensive than Windows is Mac.

- On a Mac, very few applications and nearly no games will work.

- GNU's response to Windows and Mac is Linux. This does indeed imply that Linux is free.Free means that you can download, alter, and share it without spending any money.

- The operating system Linux is not complete. It is merely a kernel.

- There aren't many companies selling Linux-based computers. Typically, all you have to do is purchase a Windows computer, format the hard drive, and install Linux yourself.

Client Software

Client software is a specialized application that is installed on your computer and can be used to communicate with another piece of software through a network. Your desktop version of Microsoft Outlook is a software client, as are web browsers. Typically, when someone uses the word "programme," they mean a particular kind of software client. But there are some differences between the two. Although all programmes are software clients, not all programmes are client software. just the majority of those we consider.
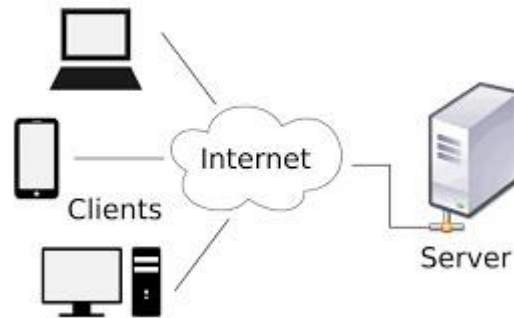
Figure 31- Client Softwarer

Software Firewall

The monitoring and filtering of incoming and outgoing network traffic by a firewall, a network security tool, is done in accordance with the security policies that have already been defined by the company. A strong firewall will offer much more than just network security from hackers and online criminals. Firewalls are used to automate your defences and collect security information on common hazards. An umbrella of protection is unfurled over all other computers connected to the network when a software firewall is deployed on a server. Ex: Avast, SonicWall, Surf shark, Fortigate
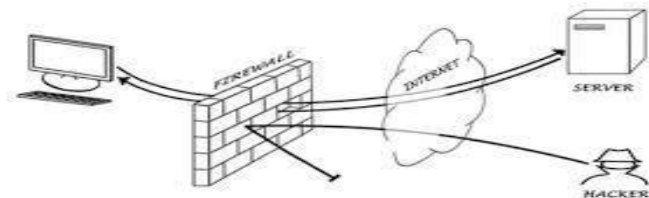
Figure 32- Software Firewall

The project's primary goal is to give SYNTAX SOLUTIONS a dependable network. Here, we must apply network design to a brand-new building that the management bought in Matara. There are 7 departments, and we have divided them up using VLAN. Additionally, the sales and marketing teams require Wi-Fi connectivity.

Network Design
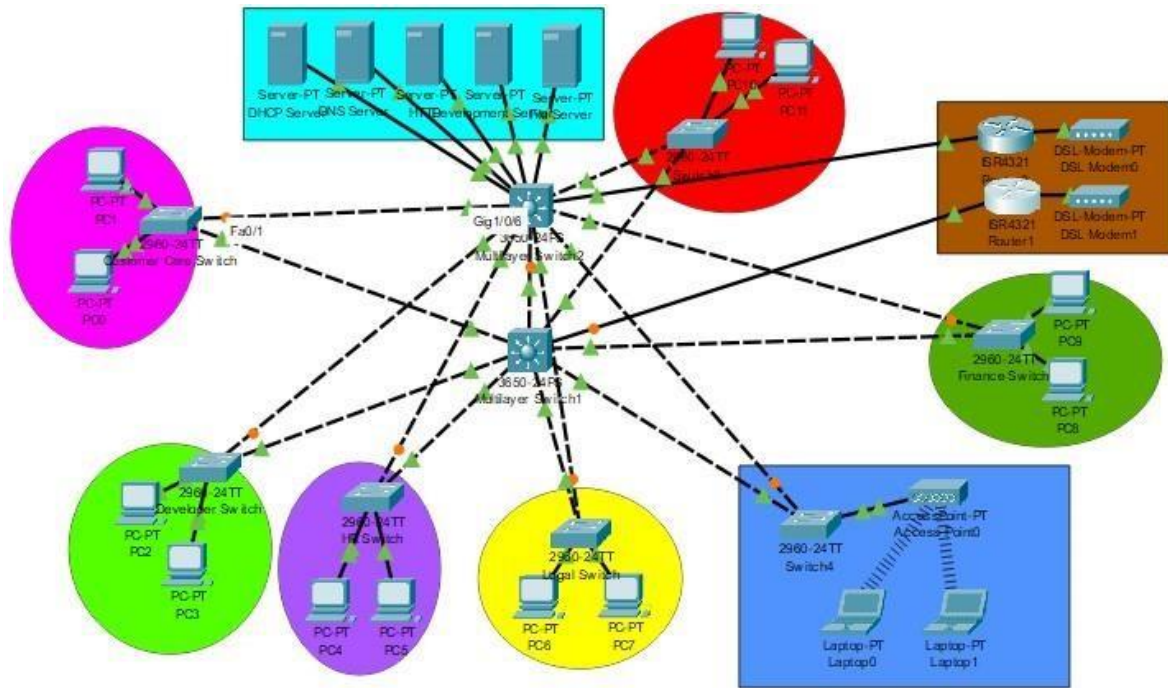
Figure 33- Network Design

Here is the blue print for the network system drawn by Edrwmax
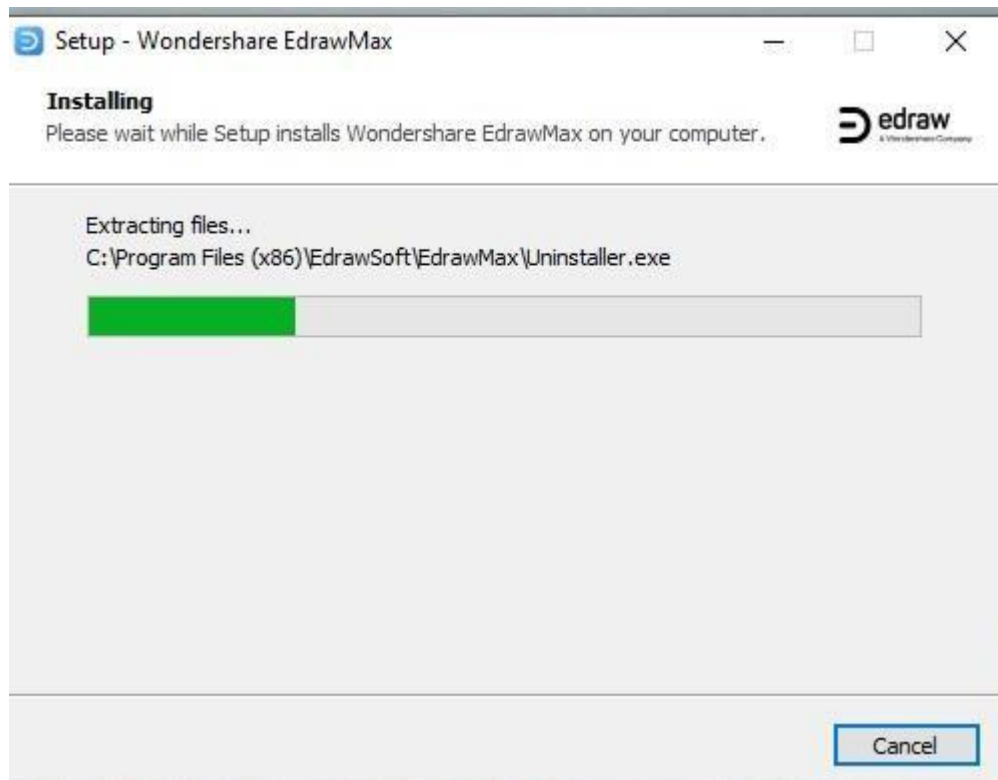
Figure 34- Wondershare Edraw Max Installing
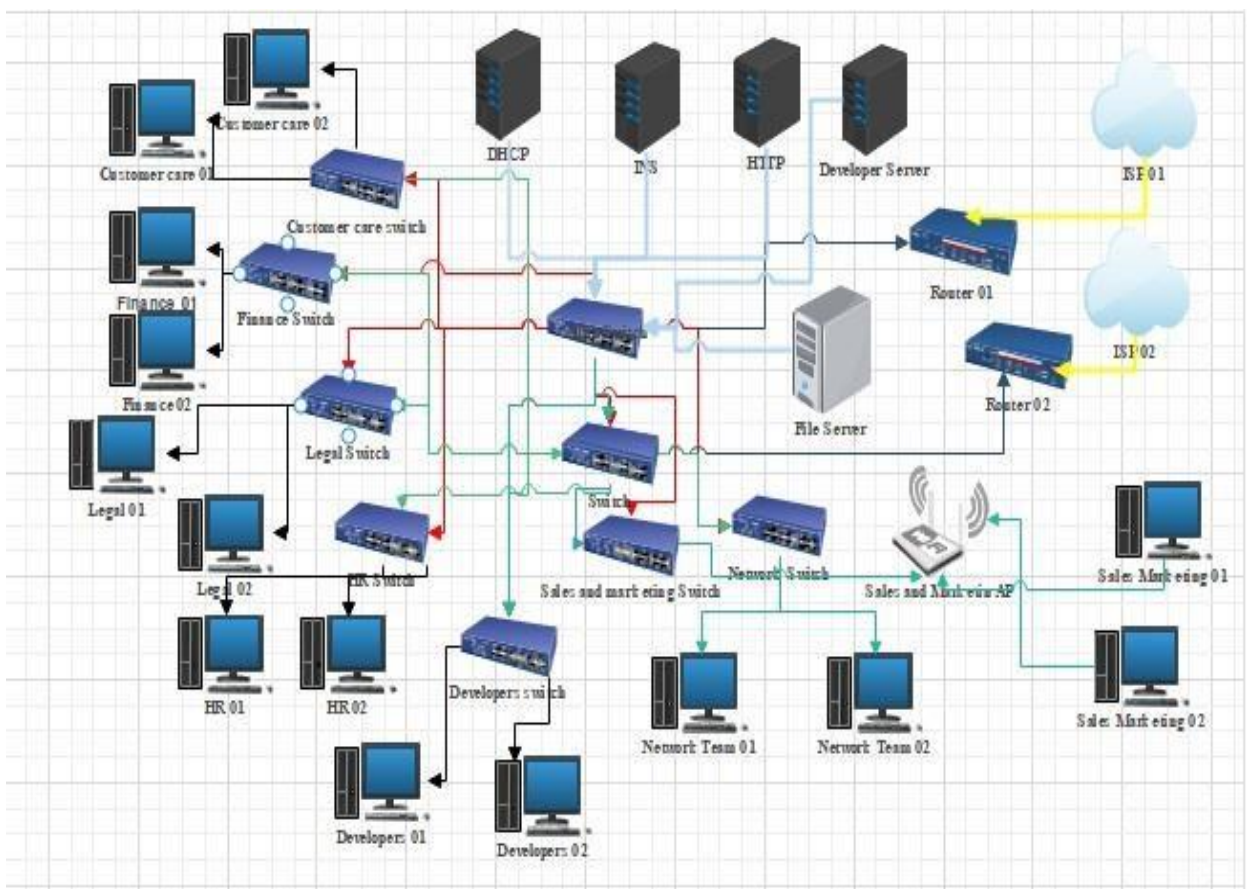
Figure 35- Blue Print

Here is the List of components and network devices that we used for the SYNTAX Solutions

Routers

Switches

Servers

PCs

Wife Access point

UTP

Keystone Jack

Connectors

Wall mount Rack

Cable

Ip Subnet Scheme

Table 9- IP Subnet Scheme

Department	Number Of users	Vlan ID	Network ID	Broadcast ID	Subnet Mask
Sales and marketing	20	10	192.168.10.96	192.168.10.127	255.255.255.224
Customer care	15	20	192.168.10.144	192.168.10.159	255.255.255.240
Finance	25	30	192.168.10.64	192.168.10.95	255.255.255.224
Legal	5	40	192.168.10.160	192.168.10.167	255.255.255.248
HR	10	50	192.168.10.128	192.168.10.143	255.255.255.240
Developers	65	60	192.168.10.0	192.168.10.68	255.255.255.192
Server Room	5	70	10.254.1.0	10.254.1.255	255.255.255.0
Network Team	5	80	192.168.10.168	192.168.10.175	255.255.255.248

DHCP service Configure

Figure 36- DHCP Configure

Syntax Solutions

Feedback form for New Syntax Solutions network

pvth456@gmail.com (not shared) Switch accounts

*Required

Email address *

Your answer
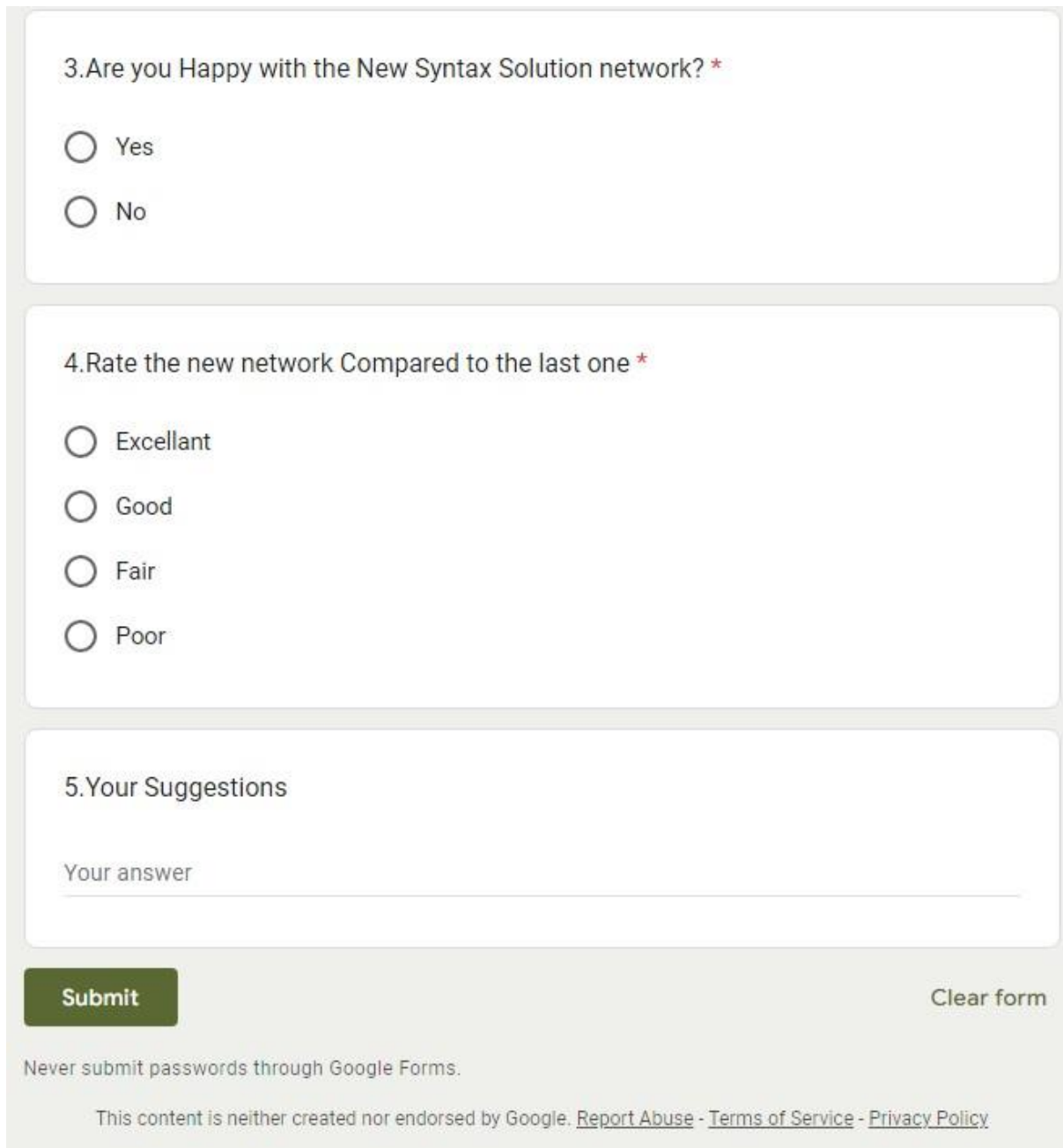
1.Name *

Your answer

2.Date *

Date

mm/dd/yyyy

Figure 37- FeedBack Form

By creating a feedback form like this, we can get an accurate measure of the effectiveness of our system. Also, it helps us to measure customer satisfaction. We can take valuable opinions from the feedback forms. After taking their opinions we can update our network to create the best customer experience.

Here are some responses

3.Are you Happy with the New Syntax Solution network?   Copy

3 responses

● Yes
● No

100%

4.Rate the new network Compared to the last one   Copy

3 responses

● Excellant
● Good
● Fair
● Poor

33.3%

66.7%

5.Your Suggestions

3 responses

It is very well done. Although I saw some minor flaws, I think they will be resolved in the next update

That's very good. Suitable for today's times. Keep it up.

That's good. Keep it up

Figure 38- Responses for the Feedback Form

Maintenance Plan to the above network

Once per week, each network cable connection needs to be examined.

To troubleshoot issues in the network, trace route testing must be used.

Employees must exercise extreme caution when working in the server room, keep it clean, and assess other equipment once a week to check for damage.

Place all rack-mounted switches in rooms with air conditioning.

While managing the network, the IT personnel should be vigilant for any suspicious activity and document it.

If you have to replace a component use the correct product mentioned in the system.

The organization must immediately notify the network consultant of any network issues.

Network Monitoring

Network monitoring gives network administrators the knowledge they need to assess a network's performance in real time. Administrators may proactively uncover flaws, maximize productivity, and more with solutions like networking monitoring software. Protocols are used by network monitoring systems to find and document problems with network performance. The integrity of the network must be continuously monitored. The best network monitoring tools offer visualization or a dashboard that shows the status of the monitored network components at a glance and alerts the user to any abnormal parameters that need further investigation or components like switches, routers, firewalls, servers, and software services, applications, or URLs that might be the cause of network disturbances. Here are some network monitoring tools,

- SolarWinds® Network Performance Monitor (NPM)
- ManageEngine OpManager
- Paessler PRTG Network Monitoring
- Nagios XI
- WireShark Monitoring
- Remote Monitoring & Management (RMM)

Installing the network monitoring tool
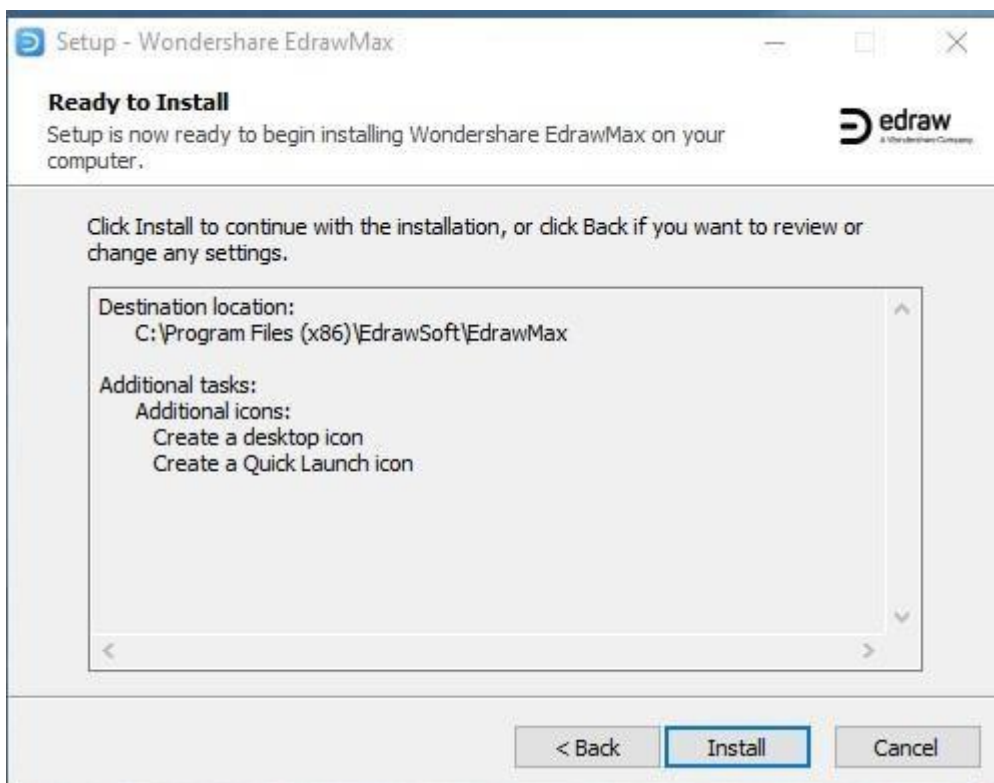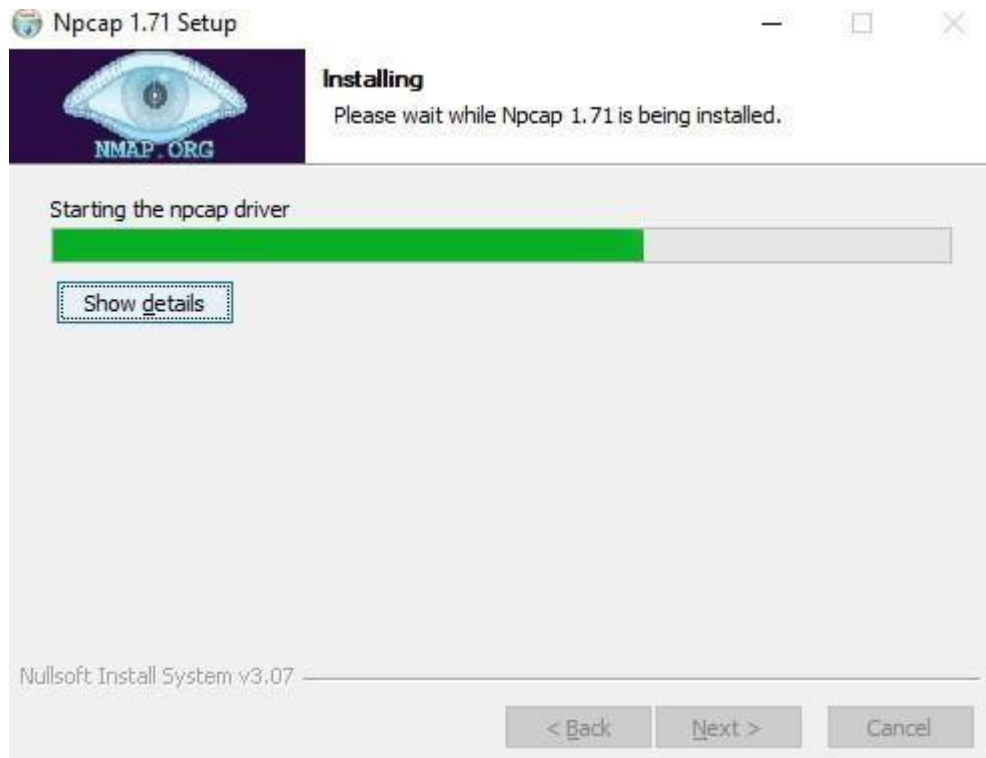
Figure 39- Installing the Wireshark

Configurations

HTTP Server Configuration

SSH
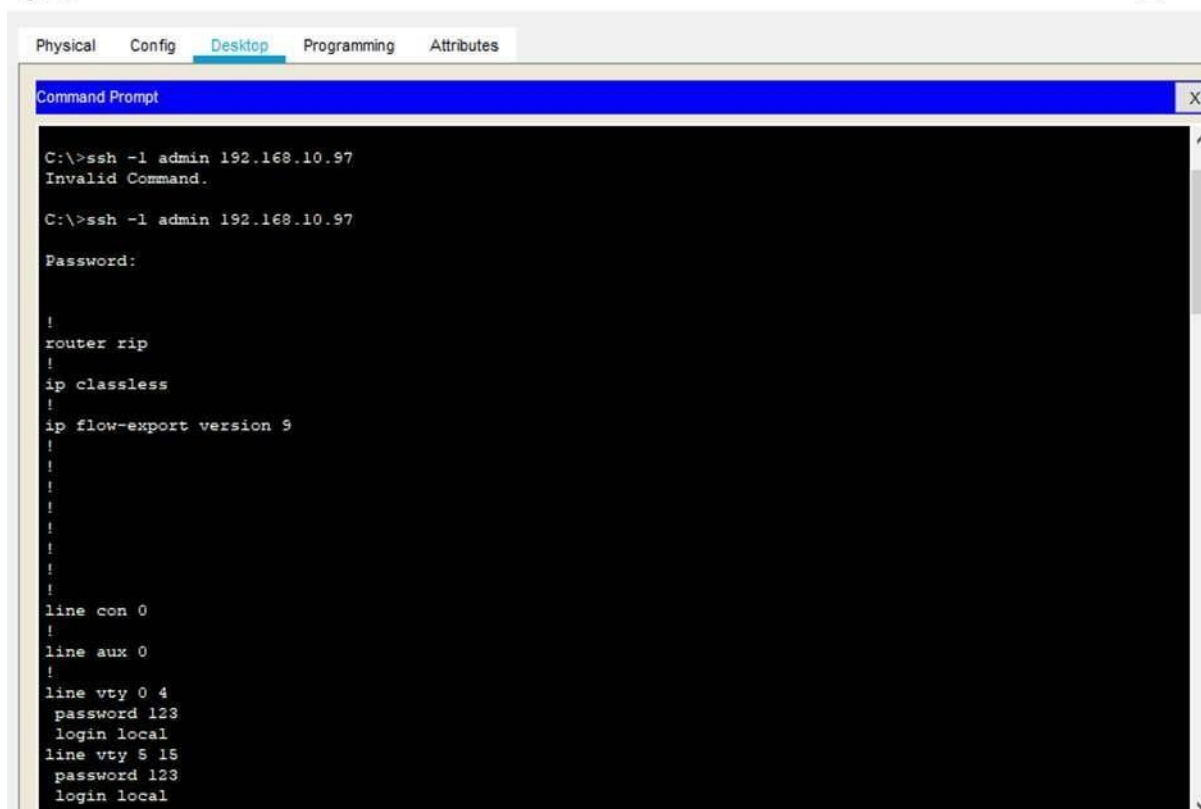
Laptop Connecting to access point

Potential future enhancements for the networked system

The aforementioned network is intended with a very limited budget. Some compromises were made in order to conserve the organization's limited budget because this network frequently operates on a very small budget. These restrictions led to some good to acquire the network and security measures being disregarded. A firewall would assist control how the company uses its information while also securing the computers used for business purposes when they are browsing the internet. Another crucial component would be a central digital computer where each user may keep the most important information about their daily tasks. It might be safeguarded and kept redundant in case of emergencies like workstation malfunction.

Conclusion

I was able to learn many aspects of networking in this unit. I think you will also gain knowledge about some aspects of this subject. Users, applications, and devices can access network services, which combine performance and functionality, to carry out their tasks on the system. In this unit you can see the basic theories of networking and learners can take knowledge about the practical site also. You must understand what services are, how they interact with one another, and how to classify them in order to construct and create a network to serve them. As you move forward with the network analysis, you will have a broad understanding of what the network will need to support, which you can then take to the next levels of detail. Also, it has managed to provide basic knowledge about some of the simplest software used in networking.

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