
Implementation of a secured Local Area Network (LAN): a matter of necessity in the School of Engineering, Isa Mustapha Agwai I Polytechnic Lafia (IMAP), Nasarawa State

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ABSTRACT: *This is a position paper, concerned with the installation and implementation of a Local Area Network (LAN) in the School of Engineering, Isa Mustapha Agwai I Polytechnic (IMAP), Lafia. The paper basically describes the guidelines for a LAN installation and implementation especially in an academic setting. It identifies the benefits of having a full implementation of a secured LAN and, points out the different possible drawbacks that could militate against successful implementation of a LAN in the School. The paper specifically highlights the supposed simple network design and the hardware tools required for effective LAN installation and implementation. It also describes the network configuration procedures including maintaining/checking and controlling the network. It further covers the aspects of determining and assigning IP addresses to connected computers in the network. The article also describes a number of possible security threats associated with LAN implementation and identifies measures on how they could be abated. The paper ends with a few suggestions including that, the School of Engineering, IMAP should go for a full implementation of a secured LAN. This is necessary for effective communication, resource sharing and file security within the school, department and the institution at large.*

Keywords: *LAN, Deployment, Implementation, IP-address, Storage*

Introduction

The importance of effective resource sharing, file storage and security, and effective communication in an academic setting cannot be overemphasized. ICT has made it possible for institutions or an organization in a networked situation to share a single resource among the various users who are supposed to in an ordinary scenario to have the same resource installed individually. This practice helps to save cost and, in addition to resources sharing comes the issue of electronic transmission of files, and file security obtainable in a networked scenario. All of these make administration easy and, a simple implementation of a secured LAN can do the magic.

Local Area Network (LAN) is a collection of devices connected together in one physical location, such as a building, office, or home [1]. A LAN can be small or large, ranging from a home network with one user to an enterprise network with thousands of users and devices in an office or school. It is (LAN) is a group of computers and associated devices that share a common communications line or wireless link [2]. Usually, the server has applications and data storage that are shared in common by multiple computer users. Many academic institutions now days implement local area networks (LANs) which allows sharing of resources like printers, files, applications as well as projects [4].

LANs also enable computers to talk to one another and are often used to share Internet access across all of the computers in a building or school. Most LANs use wires, or cables, to connect computers and other peripheral devices.

In most LAN networks, network cable is used to connect computers to a network jack in the wall [5]. Sometimes, in a classroom, many computers are connected to an intermediate hub or switch, not directly to the network jack. The hub or switch into which all of the computers are plugged is the device that is connected to the network jack. In both cases, the network jack is connected to a small router by another cable and, this paves way for resource sharing [5][6].

In a LAN, each computer has its own MAC Address, which is temporarily stored on a switch or router when communicating. All computers on the LAN can be identified by a MAC address, which can send and receive messages and data. Of course, the MAC address is stored on the network adapter and the motherboard of each computer. On older computers, network adapters are not built into the motherboard, but they are made with motherboards on newer computers [10][13].

There are generally, two types of LANs: client/server LANs and peer-to-peer LANs [9].

A client/server LAN consists of several devices (the clients) connected to a central server. The server manages file storage, application access, device access, and network traffic. A client can be any connected device that runs or accesses applications or the Internet. The clients connect to the server either with cables or through wireless connections [9]. Typically, suites of applications can be kept on the LAN server. Users can access databases, email, document sharing, printing, and other services through applications running on the LAN server, with read and write access maintained by a network or IT administrator. Most midsize to large business, government, research, and education networks are client/server-based LANs.

A peer-to-peer LAN doesn't have a central server and cannot handle heavy workloads like a client/server LAN can, and so they're typically smaller. On a peer-to-peer LAN, each device

shares equally in the functioning of the network. The devices share resources and data through wired or wireless connections to a switch or router. Most home networks are peer-to-peer [11][9]

Benefits of setting up a Local Area Network (LAN)

The following are benefits LAN:

1. Resource sharing:

a. hardware: All resources (hardware) can be shared by all connected computers [7][8]. For instance, the connected computers can share resources like DVD drives, printers, scanners, modems, and hardware drives. Therefore, there is no need to buy separate resources for each computer, and with this, you can save costs [9]. Also, all data of connected computers can be stored on one server. If each computer (client) needs specific data, the user can easily log in and access the data from the server. For example, movies and songs can be stored on a server and accessed by any authorized user (user computer) [11]

b. internet: Internet connection can be shared between all computers in the facility. In this, the main Internet cable is connected to a server and distributed through the operating system among the connected computers [10].

c. applications and software: Applications and software can be easily shared over a LAN. You can use licensed software so that any user can use it on the network. Purchasing a license for each user can cost the organization a lot of money, so subscribing to the software program is easy and at the lowest cost [12].

2. Data security:

Data storage on the server is highly secured. For instance, if there is a need to modify or delete data, it can easily be done on a server computer, and other computers can access the updated data. On the other hand, the admin can allow access to specific users to access the data in the network [9][11].

3. Easy and fast communication:

In local area networks, users (computers) can exchange data and messages easily and quickly [12]. This saves time and gets things done faster. LAN allows any user to share messages and data with any other user on the network. Users can access the network from any computer and access the data stored on the server.

Implementation of a LAN (Network Design)

This involves design, planning and deployment of a LAN solution. Building a well-secured LAN requires designing of network topology before deciding which physical devices to be purchased or technologies to deploy [13].

A topology design is defined as the identification of networks and their interconnection points, the size and the scope of the network, and the type of interconnecting devices used [15]. Every network requires a structured planning and designing before its deployment that requires internet access [16]. To visualize the networks arrangements, a designer has to make communication schemes Networks. This will help to determine where exactly each of the cables, laptops, telephones, etc. will be laid. The following Network Diagrams solution could be applied in the school of engineering -IMAP.

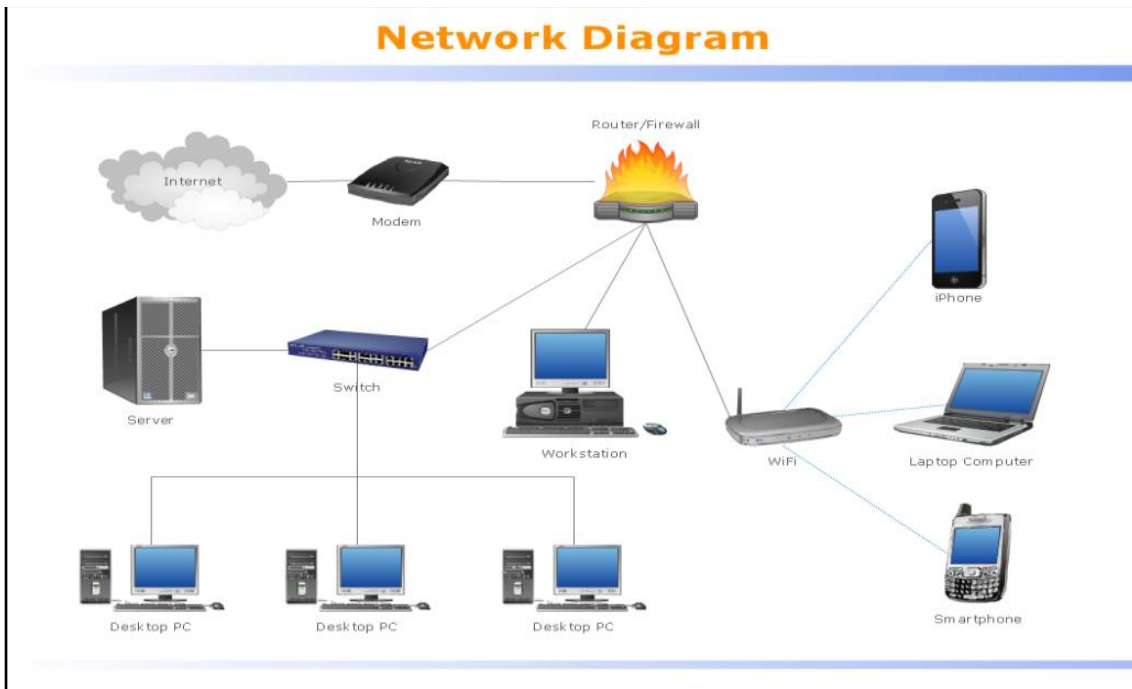


Figure 1: Network Diagram

Hardware Tools

In setting up a LAN network, it is important to make good selection of devices. Studies identified the following as appropriate LAN hardware tools for a unit in an academic institution [14][9][20][21]:

- **Cisco Router Model 2901:** this is reliable and trusted by IT community. It has good bandwidth with support for IOS upgrade.
- **Cisco Switch Model 2960:** this is tested and performs well for IT backbone.
- **Cable and Connector:** A Cat-6 cable- it is the best for LAN wearing (it has really good shielded protection) and RJ 45 connector.
- **Servers:** Server Selection is important for each server services. Many reputed ISP in Nigeria runs with brand servers. Need to choose a brand which spare parts are available.

Sample LAN Diagram

The following figure is a perfect sample of how the school of engineering, IMAP can lay out a network.

Figure.2: Local Area Network (LAN) Diagram

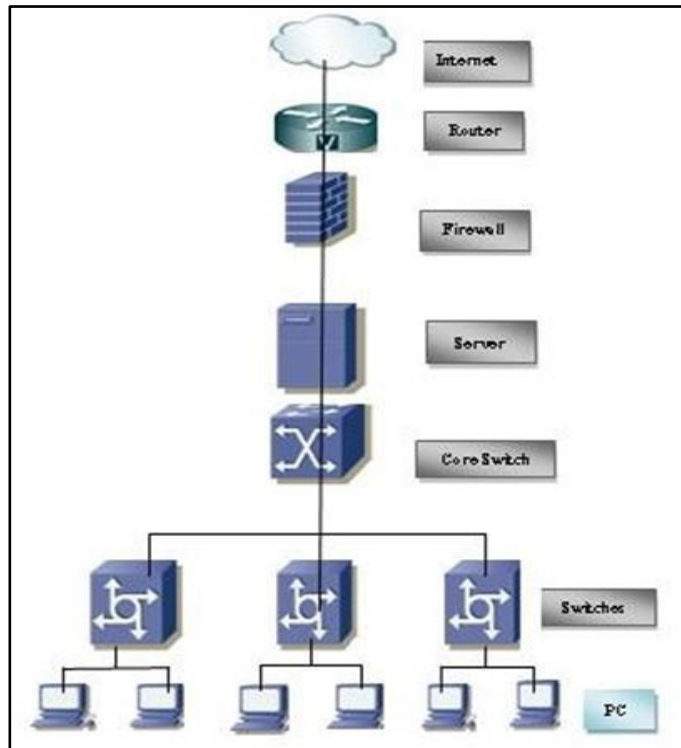
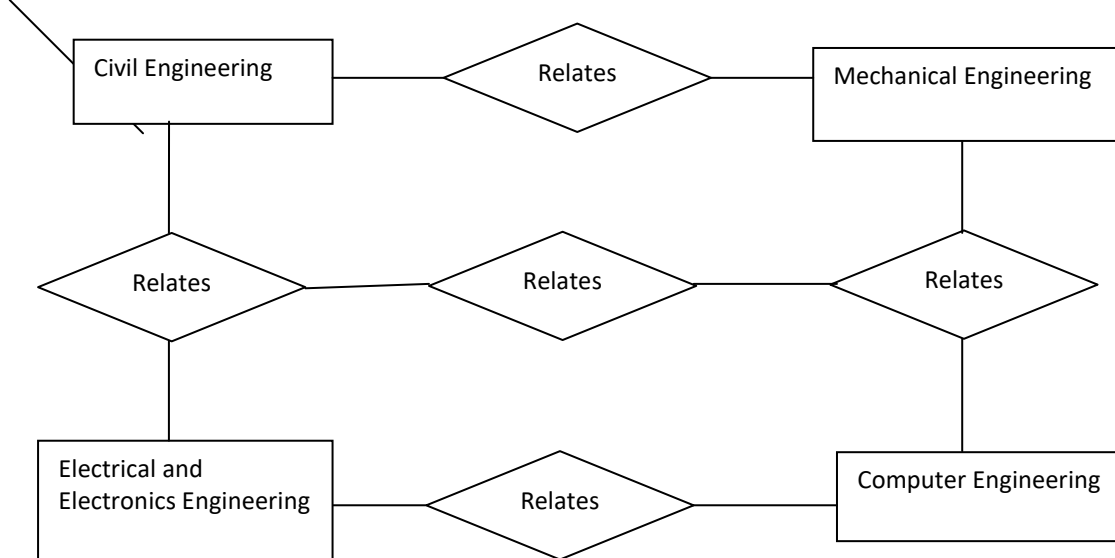


Fig 3. The relationship diagram of school of engineering, IMAP



Configuration of a LAN

Devices to configure:

The following devices are to be configured when setting up a LAN [21][17][16]

- **Router:** First, the router should be configured using terminal emulator software. The PC to be used should have standard communication port (Com-1) that connects Router's console to Pc's communication port.

- **Server:** Proxy Server satisfies going to the internet directly. This is how it works-when a user sends any web request:- the proxy web browser queries the server by sending page request. Proxy does two main operations. First is to reduce internet bandwidth charges, and the second is to limit web access to authorized user/PC.
- **Operating System:** if is your choice is LINUX then OS Centos-6.5 is most appropriate but there is need to first compare the OS with hardware compatibilities List (HCL). To install the Centos-6.5, the following steps can be followed [15][13]:
 - Disk Partition Setup.
 - Boot loader configuration.
 - Firewall configuration.
 - Root Password setting
 - Automatic selection of Package group.
 - Escape boot diskette creation.
 - Video card configurations.
 - Configuration of monitor.
 - Installation complete then reboot the system.

Linux networking facility by default supports LAN network. It offers a stalled system without a network interface card (NIC card). Networking is normally available on the interface. IO helps to run all Network related services when other NIC is not available [16][6].

Checking and Controlling the Network by “Network” service script

To start/stop network services, the following commands can be used [13]

- [root@ns1 root] # Service network stop.
- [root@ns1 root] # Service network start.
- [root@ns1 root] # Service network status.

Determining and assigning IP Addresses

All Pc's come with a NIC. When Linux OS is installed the first device is called “eth0” second one is “eth1” and so on. The IP address of the interfaces can be determined using “ifconfig” i.e [root@snmp root] # if config.

To assign IP address the “if config” can also be used. For instance, to assign an IP address on “eth0” interface using the “if config” command, you can:

```
[root@snmp root] # ifconfig eth0 10.0.0.100 net mask 255.255.255.0 up.
```

The “up” at the end of the command activates the interface after assigning the IP. But this procedure is not permanent. When the system is rebooted, the IP setting will be lost. To make this IP permanent, you can change the script file for the particular interface. All files are found in “/etc/sysconfig /network-scripts” directory. After that, a restart of the “network” service will show the effect [20][18][22]

Drawbacks to effective implementation of a LAN

According to [6][8][10][21], the following challenges may hinder effective installation and implementation of a LAN:

- **Expensive to Install:** Although a network will generally save money over time, the initial costs of installation can be prohibitive. Cables, network cards, and software are expensive, and the installation requires the services of a technician.
- **Requires Administrative Time:** Proper maintenance of a network requires considerable time and expertise. Many enterprises have installed a network, only to find that they did not budget for the necessary administrative support.
- **File Server May Fail:** Although a file server is no more susceptible to failure than any other computer, when the files server "goes down," the entire network may come to a halt. When this happens, the entire school may lose access to necessary programs and files.
- **Cables May Break:** Some of the configurations are designed to minimize the inconvenience of a broken cable; with other configurations, one broken cable can stop the entire network

Securing a LAN

In the age of ever-increasing cyber-attacks and the rising importance of cyber security, it is paramount to ensure the security of your local area network (LAN). As the backbone of most organizations, a LAN offers functionality that connects all your devices and allows for seamless data exchange. However, with great functionality comes the responsibility of securing it against vulnerabilities [21].

The following practices according to [21][23][19] will help to secure a LAN:

1. Strengthen Your Firewall- Regularly updating the network firmware can help ensure it is equipped to fend off the latest cyber threats.
2. Secure Your Wi-Fi Network- ensure the wi-fi network is secured with WPA2 or higher encryption. Rename your SSID to something unique, and always set a strong password to prevent unauthorized access.
3. Update Your Router-regular update of the router is key. Manufacturers often release patches for known vulnerabilities. Ensure you are on the lookout for these updates.
4. Use VPN for Enhanced Security- A virtual private network (VPN) provides an additional layer of security by encrypting network traffic. It can be particularly useful when accessing your LAN remotely.
5. Protect against Malware - Ensure all devices connected to your LAN, from workstations to IoT devices, have updated antivirus programs. Regular scans can help detect and remove any lurking malware.
6. Monitor Network Traffic- Regularly monitoring the network traffic can help in identifying any suspicious activities or unauthorized access. Solutions like Tufin's Orchestration Suite can be pivotal in achieving this.

Conclusion

The article provides an understanding of LAN, its benefits and how a segment of an academic institution can install or implement a secured LAN.

Suggestions

The following suggestions are put forward:

1. To save cost of buying multiple hardware and software resources, the School of Engineering, IMAP should undertake a full deployment and implementation of a LAN.
2. The Local Area Network can be extended by adding Access Point (AP) and Wi-Fi devices.

References

- [1] P. Wijuntunga, "Local Area Networks (Lans) and Their Application in Libraries," The Central Library University of Colombo, Colombo 3, Sri Lanka, [Online]. Available: <http://web.simmons.edu>.
- [2] Baird B.B, "An Experiment in Computer Conferencing Using a Local Area Network", Electronic Library, June 1987.
- [3] T. L. Flower, "Setting Up a Public Use Local Area Network", Wilson Library Bulletin, 63 (1): 45-47, September 88.
- [4] WIKIPEDIA, "Local area network," June 2007. [Online]. Available: https://en.wikipedia.org/wiki/Local_area_network.
- [5] A. Broadband, "Importance of Internet Technology for Easy Life," 16 March 2022. [Online]. Available: <https://asianetbroadband.in/importance-of-internet-technology-for-easy-life>. [Accessed 16 March 2022].
- [6] M. Bakardjieva, "The Internet in Everyday Life," 29 July 2022. [Online]. Available: <https://people.ucalgary.ca>. [Accessed 29 July 2023].
- [7] M. Bakardjieva, "Internet Society: The Internet in Everyday Life", University of Calgary, Canada: SAGE Publications Ltd, May 31, 2021.
- [8] R. Singh, "10 Ways Internet Changed our Lives Positively – Here all we explained," 7 July 2022. [Online]. Available: <https://www.pdevice.com>. [Accessed 7th July, 2023].
- [9] W. H. Seifedine Kadry, "Design and Implementation of a LAN System", Journal of Theoretical and Applied Information Technology, 2018.
- [10] D. G. Mukesh Kumar Mishra, "Security Analysis in Open Source Linux Network," International Journal of Engineering Research & Technology (IJERT), vol. 2, no. 8, 2013.
- [11] D. G. Mukesh Kumar Mishra, "Security Analysis in Open Source Linux Network," International Journal of Engineering Research & Technology (IJERT), vol. 2, no. 8, 2013.
- [12] M. u. m. I. M. S. A. Foez MdIqbal Hossain, "Hybrid Wireless Mesh Network," BRAC UNIVERSITY, Dhaka, 2013.
- [13] J. Pollard, "Network infrastructure security basics," [Online]. Available: <https://help.returnpath.com>.

- [14] D. Tutorial, "DCN - Network LAN Technologies," [Online]. Available: https://www.tutorialspoint.com/data_communication_computer_network/network_lan_technologies.htm.
- [15] I. D. T. a. Information, "LAN Topologies (Networking)," [Online]. Available: <https://what-when-how.com/networking/lan-topologies-networking>.
- [16] W. X. Y. BIAN, Computer network planning and design of the second edition, Machinery Industry Press, November 1, 2015.
- [17] W. John, On Measurement and Analysis of Internet Backbone Traffic, Göteborg, Sweden: Chalmers Reproservice, 2008.
- [18] S. Tech, "CAT6 UTP -Data Cable," 2017.[Online]. Available: <https://www.stl.tech/optical-interconnect-products>. [Accessed November, 2023].
- [19] Kordz, "RJ45 CAT6 Field Termination Connector & Strain Relief," 2019. [Online]. Available: <https://static1.squarespace.com>. [Accessed November, 2023].
- [20] R. Hat, "Red Hat Satellite 5.8 Proxy Installation Guide," 1 February 2017. [Online]. Available: <https://access.redhat.com/documentation>. [Accessed 1 February 2023].
- [21] Z. Technology, "Z9_CentOS_Installation_Guide_AAv7_3.3_20141003.docx," 3 October 2014. [Online]. Available: <https://zerodownsoftware.com>. [Accessed 3 October 2023].
- [22]. Information, In Depth Tutorials and. LAN Topologies (Networking). [Online] <https://what-when-how.com/networking/lantopologies-networking>.
- [23]. BIAN, WU XUE YI. 2015. Computer network planning and design of the second edition. s.l.: Machinery Industry Press. 28. John, Wolfgang. 2008. On Measurement and Analysis of Internet Backbone Traffic. Göteborg, Sweden: Chalmers Reproservice.