# IMPLEMENTATION OF LOCAL AREA NETWORK (LAN) AND BUILD A SECURE LAN SYSTEM FOR ATOMIC ENERGY RESEARCH ESTABLISHMENT (AERE)

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## ABSTRACT

*We live in age of modern science. Computer Network is the best innovation of Modern science. A local area network (LAN) is a computer network within a small geographical area such as a home, school, computer laboratory, office building or group of buildings. A LAN is composed of inter-connected workstations and personal computers which are each capable of accessing and sharing data and devices, such as printers, scanners and data storage devices, anywhere on the LAN. LANs are characterized by higher communication and data transfer rates and the lack of any need for leased communication lines. A high-quality and correctly dimensioned network infrastructure is essential for all well- functional IT system. A Local Area Network based network can ensure high speed as well as high quality network. To fulfill the current requirements of AERE (Atomic Energy Research Establishment) considering its smooth operation of high speed internet service, LAN based network is the state-of-the-art network solution. A LAN network design refers to the specialized processes leading to a successful installation and operation of a network which includes determining the type of communication system(s) which will be carried over the network, the geographic layout, the transmission equipment required and the fiber network over which it will operate. The purpose of this Network is to design a Local Area Network (LAN) for AERE (Atomic Energy Research Establishment) and implement security measures to protect network resources and system services. To do so, I will deal with the physical and logical design of a LAN. The goal of this Network is to examine of the Local Area Network set up for AERE and build a secure LAN system.*

***KEYWORDS:*** *Secure LAN, Operating Wavelength, Route Planning, Planning & Deployment, Network Design, AERE*

## INTRODUCTION

A Computer Network is an arrangement that enables two or more computers to communicate ("talk") to each other, sharing resources, information and services [1]. Information is no. of use unless it is available at the time and place where it is required. This is especially true into day's scenario where the competition is very tough. Networking of a computer is the best means to manage information. Very often we come across the phrase "This state has very good network roads" [2]. This is basically implying that it is possible to reach every nook and corner of the state fast, easily, and comfortably. Same analogy can be extended to networks of computers. Network of computers implies linking computers through some kind of a communication links. This does not mean simply connecting the computers through some wires, instead it also includes the software that makes this hardware work, and also ensures that the information between these computers is exchanged without any loss or distortion. In short, it encompasses the whole gamut of hardware and software component that make a

computer network operate [3]. A local area network (LAN) is a collection of devices connected together in one physical location, such as a building, office, or home [4]. 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. A local area network (LAN) is a group of computers and associated devices that share a common communications line or wireless link [5]. Usually, the server has applications and data storage that are shared in common by multiple computer users. A local area network may serve as few as two or three users (for example, in a home network) [6]. Networks are divided into two main categories: Local Area Networks (LANs) and Wide Area Networks (WANs). These two types of networks have different characteristics and different functionalities. In general, a LAN is a collection of computers and peripheral devices in a limited area such as a building or campus [7]. A LAN is usually under the domain of a single organization such as an institutional or department. The internet is, however, more than just a physical connection of LANs, internetworking protocols and standards are also needed. Network's models serve to organize, unity, and control the hardware and software components of communication and networking. The Internet has revolutionized many aspects of our daily lives [8]. It has affected the way we do business as well as the way we spend our leisure time. Count the ways you have use the internet recently. Perhaps you have sent electronic mail (email) to a business associate, paid a utility bill, read a newspaper from a distant city, or looked up a local movie schedule all by using the internet or maybe you researched a medical topic, booked a hotel reservation, chatted with a fellow trekker or comparison shopped for a car. The internet is a communication system that has brought a wealth of information to our fingertips and organized it for out use [9] [10] [11]. The internet is a structured, organized system. Bangladesh Atomic Energy Commission is a scientific research organization and regulatory body of Bangladesh. Its main objective is to promote use of atomic energy for peaceful purposes. It was established on 27 February 1973. So it is important to Design, Deployment and Implementation of Local Area Network (LAN) at AERE (Atomic Energy Research Establishment).

## RESEARCH BACK GROUND

### Local Area Network

Like any other data communication network, a local area network is composed of three basic hardware elements: a transmission medium, often twisted pair, coaxial cable, or fiber optics; a mechanism for control of transmission over the medium; and an interface to the network for the host computers or other devices-the nodes of the network-that are connected to the network. In addition, local area networks share with long-haul packet communication networks a fourth basic element: a set of software protocols, implemented in the host computers or other devices connected to the networks, which control the transmission of information from one host or device to another via the hardware elements of the network. These software protocols function at various levels, from low level packet transport protocols to high-level application protocols, and are an integral part of both local area networks and their close relatives, long-haul packet communication networks. This combined hardware-software approach to communication serves to distinguish networks, as discussed in this paper, from other arrangements of data communication hardware [12].

### Optical Fiber

An optical fiber is a flexible, transparent fiber made by drawing glass (silica) or plastic to a diameter slightly thicker than that of a human hair. Optical fibers are used most often as a means to transmit light between the two ends of the fiber and find wide usage in fiber-optic communications, where they permit transmission over longer distances and at higher

bandwidths (data transfer rates) than electrical cables. Fibers are used instead of metal wires because signals travel along them with less loss; in addition, fibers are immune to electromagnetic interference, a problem from which metal wires suffer. Fibers are also used for illumination and imaging, and are often wrapped in bundles so they may be used to carry light into, or images out of confined spaces, as in the case of a fiberscope. Specially designed fibers are also used for a variety of other applications, some of them being fiber optic sensors and fiber lasers [13].

**Atomic Energy Research Establishment (AERE)**

President Sheikh Mujibur Rahman ordered the establishment of an atomic research institute in 27 January 1973. Most of the research centers and educational institutions of Pakistan Atomic Energy Commission were in West Pakistan. After the Bangladesh Liberation war, Bangladesh only possessed were Atomic Energy Centre in Dhaka, Bangladesh Institute of Nuclear Agriculture and three nuclear medical centers [14]. Atomic Energy Research Establishment was established in 1975 at Ganakbari, Savar Upazila, Dhaka District. It was placed under the administration of Bangladesh Atomic Energy Commission, which had been facing manpower shortages since the Independence of Bangladesh in 1971 [15].

**Bangladesh Telecommunication Company Limited**

BTCL or Bangladesh Telecommunication Company Limited is the largest telecommunications company in Bangladesh. The company was founded as the Bangladesh Telegraph & Telephone Board (BTTB) Bangladesh's independence in 1971. On July 1, 2008 the BTTB became a public limited company and was renamed as BTCL [16].

**Transmission Windows**

Optical fiber transmission uses wavelengths that are in the near-infrared portion of the spectrum, just above the visible, and thus undetectable to the unaided eye. Typical optical transmission wavelengths are 850 nm, 1310 nm, and 1550 nm. Both lasers and LEDs are used to transmit light through optical fiber. Lasers are usually used for 1310- or 1550-nm single-mode applications. LEDs are used for 850- or 1300-nm multimode applications [17].

**Table 1: Fiber Optic Wavelength**

| Window | Operating Wavelength |
|--------|---------------------|
| 800-900 nm | 850 nm |
| 1250-1350 nm | 1310 nm |
| 1500-1600 nm | 1.     nm |

## METHODOLOGY

Methodology is a system that how the process is gone. In my research paper, I have practically shown The Local Area Network with secure system. The following Block diagram is showing in my research paper methodology:
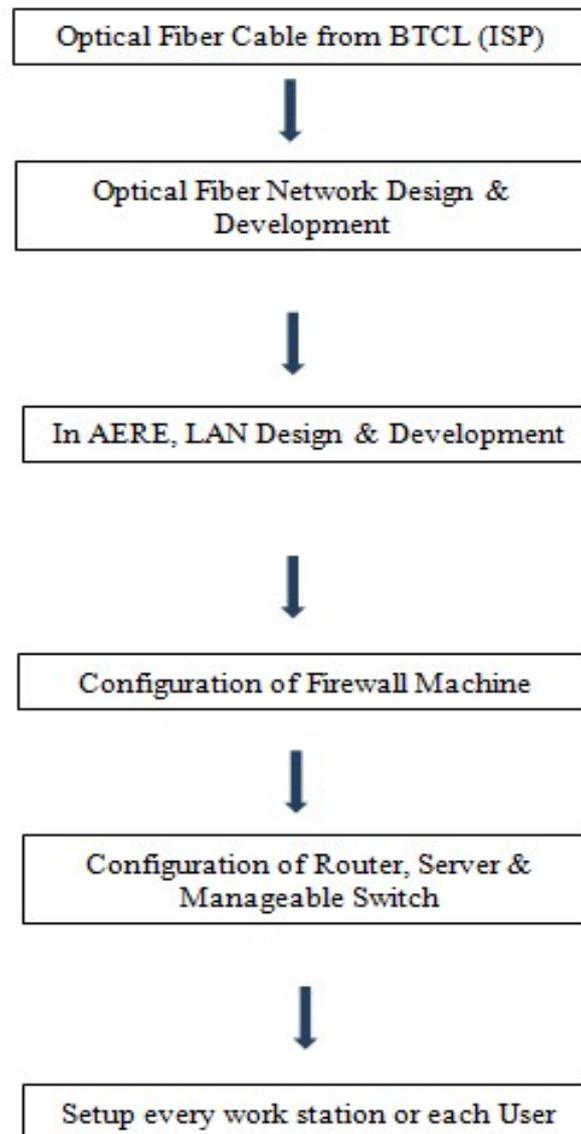
**Figure 1: Block Diagram of Whole System Methodology.**

**Optical Fiber and Local Area Network Design**

Next I consider actual component selection, placement, installation practices, testing, troubleshooting and network equipment installation and startup. Finally, I consider documentation, maintenance and planning for restoration in event of an outage.
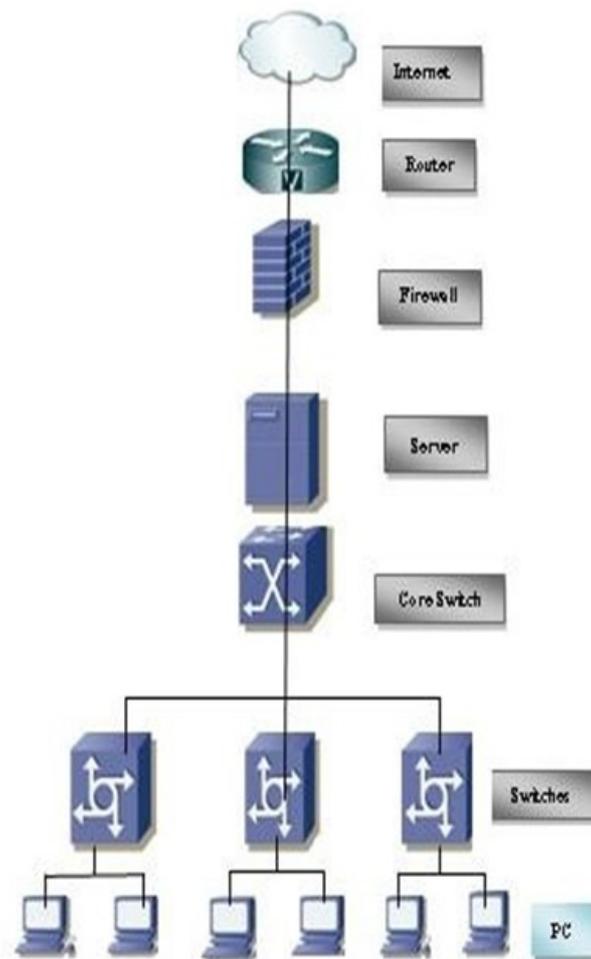
*Implementation of Local Area Network (LAN) and Build a Secure LAN System*
*for Atomic Energy Research Establishment (AERE)*

*49*

**Figure 2: Local Area Network Design at AERE.**

My existing local area network (LAN) consists of computer network that interconnects computers situated in different buildings at AERE using network media. Inside LAN, our employees are offered a computer network design applying metallic structured cabling CAT6. This cabling enables data transfer up to 100 Mbps. The network backbone is then customized using optical links. I perform dimensioning of active elements, such as switches and routers, to ensure their margin was sufficient to meet our data throughput rate requirements. I provide 10 Mbps internet bandwidth from BTCL for high speed broadband internet services. I select Multi mode fiber (MF), four core cable for our network to cover all ICT services, such as voice, video, data, wireless access, security, surveillance and building automation.

**Optical Fiber Route Planning & Deployment from BTCL to AERE and LAN Setup**

In the next step, I start planning the route of optical fiber from ICS (Institute of Computer science) to CAD (Central administration Department) to determine exactly where the cable plant and hardware will be located having decided to use fiber optics and chosen equipment appropriate for the application. As every installation is unique, the actual placement of the cable plant is determined by the physical locations from ICS to CAD building along the route. The route distance is 500 meter and I deploy the cable in the underground. Furthermore, as always premises and outside plant installations are different so I consider them separately.
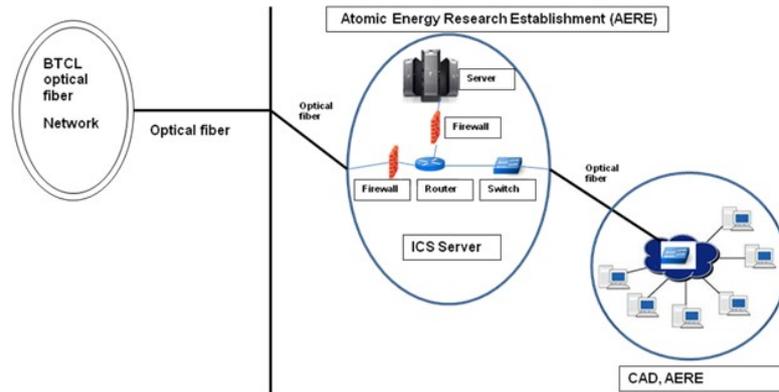
**Figure 3: Optical Fiber and Local Area Network Design & Deployment at AERE.**

Final planning for the deployment is a critical phase of any work as it involves coordinating activates of many people [18]. I develop a checklist based on the design path for smooth installation.

## NETWORK SECURITY

### Network Security Essential

Network security has become more important to personal computer users, organizations, and the military. With the advent of the internet, security became a major concern and the history of security allows a better understanding of the emergence of security technology. The internet structure itself allowed for many security threats to occur. The architecture of the internet, when modified can reduce the possible attacks that can be sent across the network. Knowing the attack methods, allows for the appropriate security to emerge. Many businesses secure themselves from the internet by means of firewalls and encryption mechanisms. The businesses create an "intranet" to remain connected to the internet but secured from possible threats. The entire field of network security is vast and in an evolutionary stage. The range of study encompasses a brief history dating back to internet's beginnings and the current development in network security. In order to understand the research being performed today, background knowledge of the internet, its vulnerabilities, attack methods through the internet, and security technology is important and therefore they are reviewed [19]. When developing a secure network, the following need to be considered: 1. Access– Authorized users are provided the means to communicate to and from a particular network 2. Confidentiality– Information in the network remains private 3. Authentication – Ensure the users of the network are who they say they are 4. Integrity – Ensure the message has not been modified in transit 5. Non-repudiation – Ensure the user does not refute that he used the network [20].

### Security Services

It is a processing or communication service that is provided by a system to give a specific kind of production to system resources. Security services implement security policies and are implemented by security mechanisms. Security Services are Confidentiality, Authentication, Peer Entity Authentication, Data Origin Authentication, Integrity, Connection Oriented Integrity [21].

### Basic Technologies of Computer Network Security

The basic technologies of computer network securities are Firewall technology, Data encryption technology, Intrusion detection technology, Anti-virus technology [22].

**Types of Attacks**

4 Types of Attacks 1) Interception: Watches packets 2) Interruption: Steals or disturbs the data 3) Modification: Changes the data 4) Fabrication: Sends another message apart from original but having the same sender name [23].

**Security Protocols**

**a) Secure Socket Layer**

It is used in secure exchange of information between web browser and web server. It gives 2 security services. 1. Authentication 2. Confidentiality It has five layers:

| |
|---|
| Application Layer |
| Secure Socket Layer |
| Transport Layer |
| Internet Layer |
| Data Link Layer |
| Physical Layer |

**Transport Layer uses HMAC**

SSL have 3 sub protocol. Handshake protocol– Connection Establishment. Record protocol –Actual message protocol. Alert Protocol - If client/ server detects error other party discloses the connection and the secret key is deleted.

**Computer Network Information Security Policy**

**Set up a Firewall**

Firewalls are an important means to ensure network security, network management applications through the use of technology, packet filtering technology and agent technology, effectively control network access permissions, comprehensive data to external restrictions and discrimination [24].

**Access Control**

Security policy and security model based on access control body set access permissions, such as to the identity of the user, password authentication, in order to gain the true identity of the user, to facilitate tracing network behavior [24].

**Strengthening Intrusion Detection**

Network intrusion detection is a real-time network detection system can effectively compensate for the lack of firewalls and other protective means [24].

**Information Encrypted**

Information technology is the key encryption technology to achieve information security, help strengthen security, through a particular encryption algorithm translated the important plaintext cipher text, so unauthorized users can not directly read the raw data, even if the data file is lost or stolen, as long as difficult to crack the key, so it will not lead to the leakage of confidential information, which greatly ensure information security [24].

**Close some not Commonly used Services and Ports**

From the theory in terms of computer security, computer systems were more port system is also more secure. For using the computer in the process, especially when the operating system is installed in inadvertently will not have to install some service functions and ports, it will not only occupy a certain system information and also reduce the security of computer systems sex. In addition, in order to understand the use of the user interface can be installed port monitoring program. It can be determined by examining those ports are not commonly used. In addition, once a virus into a computer system, the monitoring program can automatically alarm, some of the function can automatically shut down the port, effectively prevent hacker intrusion [24].

**IP Addresses are Correct Hidden PC**

IP address of the hacker and virus attacks must have a condition that is on the network and information attacks must have a real IP address to be a hacker to obtain the user's IP address mainly through the use of network technology to detect host information view, some of the traditional hackers and virus attacks, Flop overflow attacks and so must obtain address as preconditions. Therefore, the user should use a computer system when hiding your IP address, using a proxy server is the most common way to hide IP address, a hacker can only detect the proxy server IP address, but cannot get the user's real IP address You cannot find the real IP address will not be able to attack, effective maintenance of computer information and network security [24].

**Authentication Technology**

Authentication should include at least verification protocol and license agreement. A variety of network applications and computer systems are needed to confirm the legality through authentication, and then determine its personal data and specific permissions. For authentication system, the legitimate user's identity is easy to be someone else pretending to be its most important technical indicators [24].

**Timely Installation of Vulnerability Patch**

Vulnerability can be utilized during the attack weaknesses can be software, hardware, procedural shortcomings, functional design or improper configuration. University of Wisconsin Miller gives a research report on today's popular operating systems and applications, noting that the software cannot be without flaws and loopholes [24].

**File Encryption and Digital Signature Technology**

File encryption and digital signature technology is to improve the security and confidentiality of information systems and data, one of the secrets to prevent external data theft, interception or destruction primary technologies. Depending on the role, file encryption and digital signature technology is mainly divided into data transmission, data storage, data integrity of the three kinds of discrimination [24].
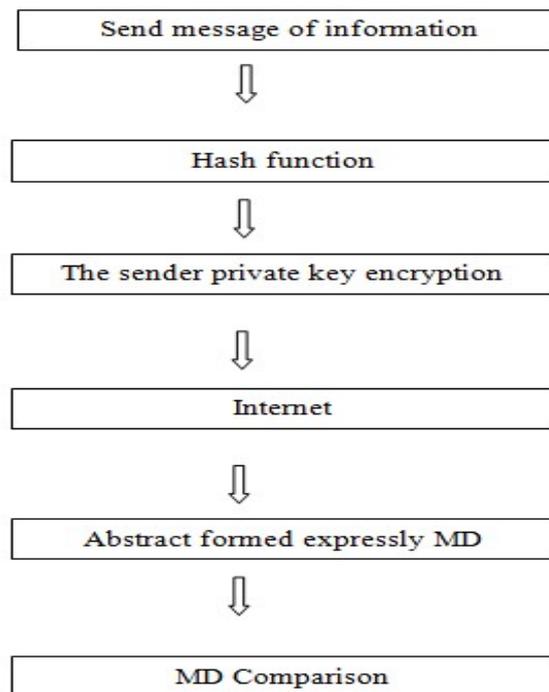
```
┌─────────────────────────────────┐
│   Send message of information   │
└─────────────────────────────────┘
                 ⇓
┌─────────────────────────────────┐
│          Hash function          │
└─────────────────────────────────┘
                 ⇓
┌─────────────────────────────────┐
│  The sender private key encryption │
└─────────────────────────────────┘
                 ⇓
┌─────────────────────────────────┐
│            Internet             │
└─────────────────────────────────┘
                 ⇓
┌─────────────────────────────────┐
│    Abstract formed expressly MD │
└─────────────────────────────────┘
                 ⇓
┌─────────────────────────────────┐
│          MD Comparison          │
└─────────────────────────────────┘
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**Figure 4: Usually the Digital Signing Process MD means Encryption Key.**

Data integrity identification technology is mainly involved in the transmission of information, access, processing of data related to the identity and to verify the contents, to confidentiality requirements, including general identification passwords, keys, identity, data items of the system by Comparative validation object input feature value meets the preset parameters, to achieve data security [24].

**Security Services and Processes**

Security is fundamentally about protecting assets. Security is a path, not a destination. As we analyze our infrastructure and applications, we identify potential threats and understand that each threat presents a degree of risk. Security is about risk management and implementing effective countermeasures. Security services and processes depends on: Authentication, Authorization, Auditing, Confidentiality, Integrity [25].

**Security in Linux Networks**

The Linux operating system is built with security features, as it provides the file access permission mechanism, which prevents the unauthorized users in gaining access to the files [26].

**Firewalls**

A firewall is one of the most widely used solutions for the Internet world. All traffic inside to outside and vice versa, must pass through the firewall. Different types of firewalls have different types of rules and security policies. The authorized traffic will be sent based only on local policies. The firewall itself is protected, i.e.; it uses a trusted hardware and operating system [27].

**CONFIGURATION**

**Configuring Router**

I install the routers hardware properly before configuring and commissioning. I install all hardware properly to avoid damage. I Read all supplied manual properly before installing router. I Take a PC/Laptop with terminal emulator software (Hyper Terminal for windows mini com for Linux). The PC should have at least a standard communication port (Com-1) connect Router's console to Pc's communication port using console cable. I Turn on Pc's and router power switch. Terminal will display router's booting information. I have successfully booted router and configure using setup facility the router is now configured properly with initial configuration and ready to use.

**Configure Server**

Proxy Server satisfies web browser's query by sending requested web page. Proxy does two main operations. First operation is to reduce internet bandwidth charges. And the second option is to limit web access to authorized user/PC. Users configure their web browser's to use the proxy server instead of going to the internet directly. When a user sends any web request, proxy takes the request. Proxy is the only service, which heavily uses CPU, memory and storage simultaneously. I Installing Operating System and then configuration following:

**Operating System**

Buying operating system (OS) in Bangladesh is really a big headache. There are very few commercial operating systems. All commercial operating systems supports are not also available locally. So, I need to depend on foreign support we choose OS Centos-6.5 which includes squid with its entire options precompiled. Server OS should have a large amount of hardware support. Compare with My operating systems hardware compatibilities List (HCL), before choosing the OS. Installation Media; Install Linux operating system from any comfortable media like CD ROM, Hard disk including all network installation method. Installing OS; I have chosenCentos-6.5 Linux operating system. All other versions installation is almost same. I cover Centos-6.5 installation step by step.

   # Disk Partition Setup.

   # Boot loader configures.

   # Firewall configure manual.

   # Set root Password.

   # Package group selection automatically.

   # Escape boot diskette creation.

   # Video card configurations.

   # Configuring monitor.

   # Installation complete then reboot the system.

Network configuration is Linux; I configure Linux server to enjoy networking features. Linux Networking Facility by default Linux support network, when I will install a system, Networking facility will be installed. Moreover, is

a stalled system without a NIC card Networking will be available with to interface. IO helps to run all Network related services when other NIC is not available we can check/control network by "Network" service script nicely (/etc/rc,d/init.d/network). Use the following command connected to start/stop network Service.

[root@ns1 root] # Service network stop. [root@ns1 root] # Service network start. [root@ns1 root] # Service network status. Determining IP address; now a day's commonly all Pc's come with a NIC, when Linux is installed this first device is called "eth0" second one is "eth1" and so on. I can determine the IP address of these interfaces using "ifconfig"

[root@snmp root] # if config.

Assigning IP address using "if config". We can assign an IP address on "eth0" interface using the" if config" command. This is the most common method.

[root@snmp root] # if config 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 I will reboot the system the IP setting will be lost. To make this IP permanent, I need to change the script file for the particular interface. All files will be found in "/etc/sysconfig /network-scripts" directory. Now restart the "network" service to take effect. I need to restart the network service each time makes any type of change into these files. [root@nsl root] # service network restart use " ifconfig" command to see the change. It will show the new IP setting. [root@snmp root] # if config. Assigning IP address using "netconfig", we can also do it automatically using some graphical utility. "netgonfig" is a beautiful utility that we can use to edit those files automatically. It will offer to fill up essential fields.

## RESULTS

My LAN networking at AERE smoothly installed. As a result of this LAN network, Atomic Energy Research Establishment (AERE) is getting a high speed internet service with Secure LAN System.

## FUTURE WORK

In Future, I will extend my Local Area Network by adding Access Point (AP) and Wi-Fi devices. I will add more network devices to service the end user who are working at Atomic Energy Research Establishment. I will always update AERE LAN System to secure and protect any kind of attacks.

## CONCLUSIONS

Today, optical fiber network is the smart network option for high-performance and it can provide cost-effective hybrid network architectures as well [28]. Furthermore, optical fiber networks are more energy-efficient and environmentally friendly [29]. In this work, I primarily focus on the unique aspects of optical fiber cable plant design and deployment and Local Area Network with Security system only. Our optical fiber network design and its deployment and LAN Secure Systems has been completed. As a result of this optical fiber network and Secure LAN System, Central Administration Division (CAD) of Atomic Energy Research Establishment (AERE) is getting a high speed internet service with Secure LAN System.

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*57*

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