

VOCATIONAL TRAINING REPORT

ON

NETWORK AND SECURITY

SUBMITTED BY

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SUBMITTED TO

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BHARAT HEAVY ELECTRICALS LIMITED (BHEL)
SIRI FORT, NEW DELHI- 110049
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PREFACE

The objective of vocational training is to learn about the industries practically and to be familiar with the working style of a technical person to adjust simply according to the industrial environment.

The advancement of digital infrastructure and the increasing reliance on information technology in industrial environments have brought network management to the forefront of operational priorities. This vocational training on **Network and Security**, undertaken at **Bharat Heavy Electricals Limited (BHEL)**, provided an invaluable opportunity to understand the foundational and practical aspects of modern networking systems, security protocols, and infrastructure management in a real-world industrial setting.

The training was structured to impart both theoretical knowledge and hands-on experience in various domains including network topology, IP addressing, routing, switching, firewall configurations, and cybersecurity best practices.

A major emphasis was also laid on identifying vulnerabilities, implementing access controls, monitoring traffic, and maintaining the integrity and confidentiality of data.

This preface marks the beginning of the documentation of my learning journey at BHEL, where I explored how secure and robust network systems are crucial for supporting the technological backbone of a leading engineering and manufacturing enterprise.

The insights gained from this experience have significantly contributed to my professional growth and understanding of industry-grade network security standards.

I extend my sincere gratitude to the training coordinators, mentors, and technical staff at BHEL for their guidance, resources, and continuous support throughout this enriching experience.

DECLARATION

I hereby declare that the report titled “**Network and Security – Vocational Training at BHEL**” is a record of the original work carried out by me during the vocational training program at **Bharat Heavy Electricals Limited (BHEL)**.

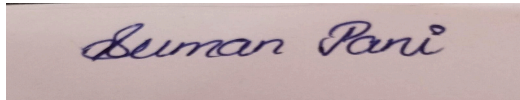
The information presented in this report is true to the best of my knowledge and belief. This report has not been submitted to any other institution or university for the award of any degree, diploma, or certificate.

I express my sincere thanks to the authorities and mentors at BHEL for providing me with the opportunity to undergo this training and gain practical exposure in the field of computer networking and cybersecurity.

Name: Suman Pani

Date: 23.07.2025

Signature:

A rectangular box containing a handwritten signature in blue ink. The signature is written in a cursive style and reads "Suman Pani".

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INTRODUCTION TO BHEL

INTRODUCTION

Bharat Heavy Electricals Limited (BHEL) is one of India's largest and most respected engineering and manufacturing companies. It was established in 1964. BHEL operates under the **Ministry of Heavy Industries**, Government of India, and holds the prestigious status of a **Maharatna** Public Sector Undertaking (PSU).

BHEL specializes in providing comprehensive services in power generation, transmission, transportation, renewable energy, and industrial systems. The company is engaged largely in the field of design, engineering, manufacturing, construction, testing, commissioning, and servicing of a wide range of products and systems for core sectors of the economy. Its extensive capabilities cover thermal, hydro, nuclear, and gas-based power equipment, as well as industrial electronics and automation.

Over the decades, BHEL has made significant contributions to the development of India's infrastructure. The organization has built a strong presence across the country with more than 16 manufacturing units, over 150 project sites, 8 service centers, and 4 regional offices. It is also a pioneer in indigenous research and development, with a focus on innovation, self-reliance, and technology modernization. BHEL has been recognized for its excellence in engineering, sustainable practices, and quality-driven processes.



Fig- BHEL First Office

The **BHEL office at Siri Fort, New Delhi**, is one of the prominent regional centers, playing a crucial role in the coordination of administrative, IT, and training-related activities. Located in the heart of South Delhi, this office supports a range of internal functions such as corporate training programs, project management, and digital infrastructure services. The Siri Fort campus is also known for hosting inter-departmental meetings, workshops, and technical sessions that contribute to the organization's operational efficiency.

BHEL continues to play a pivotal role in supporting India's vision of "**Aatmanirbhar Bharat**" (self-reliant India) by promoting indigenous manufacturing and strengthening the national technological base. With a legacy of trust and engineering excellence, BHEL remains a symbol of India's industrial capabilities and a key contributor to the nation's economic growth.

PRODUCTS

1. Gas and Steam Turbines:

BHEL has supplied over 1,000 gas turbines and 4,000 steam turbines in India and abroad.

2. Ultra High Voltage Transformer:

BHEL has supplied over 18,000 transformers upto 1,200kV of various ratings and types in India and abroad.

3. Industrial Valves:

BHEL has supplied over 3,00,000 valves of various types and sizes for power, oil and gas, petrochemical, fertilizer and other industries.

4. Power Electronics :

BHEL has supplied over 35,000 power electronic devices and systems for various applications such as traction, industrial drives, renewable energy, defence and aerospace.

5. Boilers:

BHEL has supplied over 1,90,000 MW of boilers for thermal, hydro, nuclear and solar power plants in India and abroad.

6. Electric Motors:

BHEL has supplied over 2,50,000 motors of various types and ratings for industrial, agricultural, domestic and defence applications.

7. Controlled Shunt Reactor:

BHEL has supplied over 100 controlled shunt reactors in India and abroad.

8. Electric Locomotives:

BHEL has supplied over 360 electric locomotives to the Indian Railways and exported 23 locomotives to other countries.

9. Generators:

BHEL has supplied over 2,00,000 MW of generators for thermal, hydro, nuclear and solar power plants in India and abroad.

10. Heat Exchangers:

BHEL has supplied over 40,000 heat exchangers of various types and sizes for power, oil and gas, petrochemical, fertilizer and other industries.

UNITS AND DIVISIONS

Bharat Heavy Electricals Limited (BHEL) has a widespread presence across India through its strategically located manufacturing units, service centers, R&D facilities, and regional offices.

Major manufacturing units are located in cities such as **Bhopal, Haridwar, Trichy, Hyderabad, Bengaluru, Ranipet, and Jhansi**, specializing in a diverse range of products from turbines and boilers to transformers and control systems. BHEL's **Siri Fort office in New Delhi** functions as a key administrative and IT hub. The company also operates advanced **R&D centers** in **Hyderabad, Bengaluru, and Trichy**, along with regional marketing and service offices in **Mumbai, Chennai, Kolkata, and Noida**. This vast network enables BHEL to deliver comprehensive engineering solutions and ensures timely service and support across the nation.

MANUFACTURING UNITS

1. Bhopal, Madhya Pradesh

2. Haridwar, Uttarakhand
3. Hyderabad, Telangana
4. Trichy, Tamil Nadu
5. Bangalore, Karnataka
6. Ranipet, Tamil Nadu
7. Jhansi, Uttar Pradesh
8. Tiruchirapalli, Tamil Nadu
9. Goindwal, Punjab
10. Jagdishpur, Uttar Pradesh

SERVICE CENTERS AND AND REGIONAL OPERATIONS

1. Siri Fort, New Delhi
2. Mumbai, Maharashtra
3. Chennai, Tamil Nadu
4. Kolkata, West Bengal
5. Noida, Uttar Pradesh

RESEARCH AND DEVELOPMENT CENTERS

1. Hyderabad, Telangana
2. Bangalore, Karnataka
3. Bhopal, Madhya Pradesh
4. Trichy, Tamil Nadu
5. Haridwar, Uttarakhand

INTRODUCTION TO CDT

CDT

The **Corporate Digital Transformation (CDT)** is a strategic initiative undertaken by **Bharat Heavy Electricals Limited (BHEL)** to modernize and digitize its core business processes, operations, and services.

The aim of CDT is to integrate digital technologies such as cloud computing, data analytics, cybersecurity, automation, and artificial intelligence into BHEL's existing systems to improve efficiency, productivity, transparency, and decision-making.

A data center is used to house computer systems and related components, such as telecommunications and storage systems. It serves as the backbone for storing, processing, managing, and disseminating data. Data centers are crucial for organizations to support their IT infrastructure, applications, and services.

BHEL has a data center for various purposes, including managing internal IT operations, supporting digital initiatives, or providing data hosting services for clients. A data center is integral to handling the vast amounts of data generated in modern industrial processes and ensuring its secure and efficient storage and processing.



Fig- Data Center and CDT, BHEL

Under the CDT framework, BHEL is focusing on several key areas including:

- **ERP (Enterprise Resource Planning) system upgrades**
- **Digital monitoring of project execution**
- **Smart manufacturing and Industry 4.0 practices**
- **Cybersecurity enhancement**
- **Real-time data analytics and dashboards**
- **Online procurement and vendor management systems**
- **Paperless workflows and document digitization**

The **CDT division** works in collaboration with various plants, regional offices, and IT departments—including the **BHEL Siri Fort Office in New Delhi**, which plays a central role in coordinating digital initiatives. This transformation is aligned with the Government of India's push for **Digital India** and helps BHEL remain competitive in the global market by adopting state-of-the-art digital solutions in its operations.

NETWORK AND SERVER

INTRODUCTION

In today's digital age, **computer networks** and **servers** form the backbone of all modern communication and data exchange in organizations. Whether in industrial, commercial, or educational environments, these components are essential for enabling reliable, secure, and efficient operations.

A **computer network** is defined as a group of interconnected devices (such as computers, servers, switches, routers, and other hardware) that communicate and share data, resources, and applications.

Networks can be classified into various types, including Local Area Network (LAN), Wide Area Network (WAN), Metropolitan Area Network (MAN), and more, depending on their size and scope. These networks are built using protocols such as TCP/IP, and include both wired and wireless communication technologies.

A **server** is a specialized computer system or software application that provides services, data, or resources to other computers—known as clients—over a network.

Servers play a crucial role in managing network resources and can be of various types, such as file servers, web servers, database servers, email servers, and domain controllers. They ensure centralized control, resource sharing, data security, and smooth access management in a networked environment.

Together, **networks and servers** form the core infrastructure for managing communication, data flow, and security in any large-scale enterprise like **BHEL**, where reliability and real-time operations are critical for engineering and manufacturing functions.

OSI MODEL

The **OSI(Open System Interconnections) model** is a conceptual framework that explains the process of transmitting data between computers.

It is divided into seven layers that work together to carry out specialised network functions, allowing for a more systematic approach to networking.

Seven Layers of OSI Model

1. Physical Layer:

This is the lowest layer of the OSI model and deals with the transmission of raw binary data over a physical medium. Eg- ethernet cables, fiber optics, etc.

2. Data Link Layer:

This layer ensures reliable data transfer between two directly connected nodes and handles error detection and correction. Eg- ethernet, MAC address, etc.

3. Network Layer:

Responsible for routing packets from the source to the destination across multiple networks, it handles logical addressing using IP addresses. Eg- routers, IP, etc.

4. Transport Layer:

This layer ensures complete and reliable data transmission between host systems and manages flow control, error checking, and retransmissions. Eg- TCP, UDP, etc.

5. Session Layer:

The session layer establishes, maintains, and terminates communication sessions between applications, handles authentication and session restoration in case of interruptions. Eg- RPC, session tokens, etc.

6. Presentation Layer:

This layer is responsible for data translation, encryption/decryption, and compression, ensuring that the data sent by the application layer of one system is readable by the application layer of another. Eg- SSL/TLS, JPEG, etc.

7. Application Layer: The topmost layer, it directly interacts with end-users and provides network services to applications. Eg- HTTP, FTP, etc.

TCP/IP

TCP/IP (Transmission Control Protocol/Internet Protocol) is the foundational suite of communication protocols used to interconnect devices on the internet and most private networks. It defines how data should be packetized, addressed, transmitted, routed, and received between devices across networks.

The **TCP/IP model** was developed by the U.S. Department of Defense and is based on standard protocols that allow different types of computers and networks to communicate effectively. Unlike the OSI model, which has seven layers, the TCP/IP model consists of four layers.

1. Application Layer:

This layer provides network services directly to applications and end-users. Protocols like **HTTP, FTP, SMTP, DNS, and Telnet** operate at this layer.

2. Transport Layer:

Responsible for end-to-end communication, reliability, and flow control. It includes **TCP** (reliable, connection-oriented) and **UDP** (faster, connectionless) protocols.

3. Internet Layer:

Handles logical addressing, packet forwarding, and routing. The key protocol is **IP (IPv4 or IPv6)**, along with **ICMP** and **ARP**.

4. Network Access Layer (Link Layer):

Deals with the physical transmission of data over the network medium and includes protocols like **Ethernet, Wi-Fi**, and device drivers.

TCP/IP is widely used because it is scalable, flexible, and robust, supporting both local area networks (LANs) and wide area networks (WANs), including the global Internet. It is the standard communication protocol suite in modern networking, including enterprise systems like those used by **BHEL** for industrial and administrative connectivity.

IP

IP(Internet Protocol) is a network layer protocol that is responsible for addressing and routing packets of data so that they can travel across networks and arrive at the correct destination.

IP is versioned, with IPv4 and IPv6 being the most widely used versions.

IPv4

1. It allows devices to connect to the web.
2. Each device on a network is assigned a unique IPv4 address.
3. Addresses are 32-bit integers in decimal notation like x.x.x.x. Eg.
172.16.254.1.
4. Each x can be in between 0 to 255.
5. A total of 4.3 billion addresses can be allocated in IPv4.
6. In it 18 million addresses are for private addressing.
7. Network address translation (NAT) is used to connect private devices to public networks.
8. Class of IPv4 addresses are decided by identifying the first octet. Class divides the purpose of IP address. 127 is used for a local server. Classes A, B, and C are used for public use. N for network ID. H for Host ID
 - Class A - 0 to 126, IP Address --> N.H.H.H
 - Class B - 128 to 191, IP Address --> N.N.H.H
 - Class C - 192 to 223, IP Address --> N.N.N.H
 - Class D - 224 to 239, Used for multitasking
 - Class E - 240 to 255, Used for research.

IPv6

1. It has 128-bit address space.
2. It has 8 octets and each octet ranges from 0 to FFFF.
3. It uses both letters and numbers in identifiers.

4. It has $2^{128} = 340$ undecillion unique addresses, which overcome the limitations of IPv4.

Assigning IP Address

- DHCP (Dynamic Host Configuration Protocol)
- Static IP Address Assignment
- Private IP Addresses provided by Enterprises
- Public IP Addresses provided by ISP
- Subnetting
- IPv6 Address Assignment
- Network Address Translation (NAT)

DHCP

DHCP(Dynamic Host Configuration Protocol) is a network management protocol used to automatically assign IP addresses and other network configuration settings to devices (clients) on a network, so they can communicate effectively.

When a device (such as a computer, mobile phone, or printer) connects to a network, it sends a request for an IP address. The DHCP server receives this request and dynamically assigns an available IP address along with other important settings such as subnet mask, default gateway, and DNS server addresses.

This process eliminates the need for manually configuring each device on the network, saving time and reducing configuration errors. DHCP works using a four-step process often called **DORA**.

- Discover – Client broadcasts a request to locate a DHCP server.
- Offer – DHCP server replies with an available IP address offer.
- Request – Client requests the offered IP address.
- Acknowledge – DHCP server confirms and leases the IP address to the client.

DHCP is widely used in both local area networks (LANs) and enterprise networks, making IP address management automatic and efficient.

SWITCH

A **switch** is a network device that operates at the data link layer, connecting multiple devices within a local area network. It intelligently forwards data based on MAC addresses. Managed switches offer advanced features like VLAN support and Quality of Service settings.

Layer 2 (L2) switches operate at the data link layer, forwarding data based on MAC addresses within the same network segment. Layer 3 (L3) switches operate at both the data link and network layers, combining switching with routing capabilities for inter-VLAN communication and more advanced network segmentation.

In **BHEL**, here mainly 24 and 48 port layer 2 switches are used.

PORT NUMBER

It is not a physical connection instead it is a **logical connection** that is used to exchange information. It ranges from 0 to 65535. IANA assigns port number as per requirement.

Some common ports are 80 – HTTP, 443 – HTTPS, 21 – FTP, 25 – Email.

DIVISIONS

1. 0 – 1023 -> System ports

These are general ports.

2. 1024 – 49151 -> User/Registered Ports

These are registered by companies or developers for specific work.

3. 49152 – 65535 -> Dynamic/Private Ports

These are free ports which the system assigns to themselves when using service.

SUBNET MASK

IP address contains two parts one of them is Network address and other is Host address. So, Subnet Mask helps us to find the Network and Host Part in the IP address.

VLAN

A **VLAN (Virtual Local Area Network)** is a logical subgroup within a physical network that groups together devices based on function, department, or application—regardless of their physical location. It is used to segment a network into smaller, isolated broadcast domains, improving performance, security, and manageability.

In a traditional LAN, all devices are part of the same broadcast domain, meaning that broadcast traffic is sent to all connected devices, which can lead to congestion. With VLANs, network administrators can create separate virtual networks on the same physical switch, ensuring that devices in one VLAN cannot communicate directly with devices in another VLAN without routing.

Each VLAN is identified by a unique VLAN ID (1–4094). VLANs are configured on managed switches, and devices can be assigned to a VLAN based on port number, MAC address, protocol, or authentication.

ROUTER

A **router** is a networking device that connects multiple computer networks and directs data packets between them. Its primary function is to determine the best path for data to travel from a source to its destination across interconnected networks, such as from a local network to the internet.

Routers operate mainly at **Layer 3 (Network Layer)** of the OSI model, using **IP addresses** to make routing decisions. When a device on one network wants to communicate with a device on another network, the router examines the destination IP address in each packet and forwards it toward its destination using a process called **routing**.

Routers may also include firewall capabilities, NAT (Network Address Translation), DHCP services, and VPN support.

SERVER

A **server** is a specialized computer or software that provides resources, services, or functionality to other computers (clients) in a network. It can host applications, store

data, manage network resources, or respond to client requests, using commonly 2 processors of 16 or 20 cores and both along each other.

Types of Server

1. Web Server
2. Email Server
3. Database Server

RAID (Redundant Array of Independent Disks)

It used to create backups in File Server to prevent data loss. Different types are Raid 0, Raid 1, Raid 5, Raid 10, and Raid 6

Types of File Server

1. NAS:

Network attached Storage is a single centralized storage device for storing data on a network. It also has a NIC card to connect to Switch or Router.

2. SAN:

Storage area Network is a dedicated network to store data. It works as a local hard drive for Servers.

File server uses SMB, FTP, and NFS are few protocols used in File Server.

Active Directory is used as a UI to interact with servers.

ACTIVE DIRECTORY

Active Directory (AD) is a **directory service** developed by **Microsoft** that is used to manage and organize network resources such as users, computers, printers, and security policies within a Windows domain network.

At its core, Active Directory provides a centralized database where administrators can store and manage information about network objects and control user authentication, authorization, and access permissions.

It allows organizations to enforce security policies, assign roles, and streamline user management across large and complex networks.

Active Directory operates primarily through a domain controller (DC), which handles login requests and ensures that only authorized users can access specific resources. The most commonly used service within AD is Active Directory Domain Services (AD DS).

DNS

The **Domain Name System (DNS)** is a naming system used to convert human-readable domain names (like www.google.com) into machine-readable IP addresses (like 142.250.182.4) that computers use to identify each other on a network.

DNS functions like the “**phonebook**” of the internet, allowing users to access websites and online services using easy-to-remember domain names instead of having to memorize numeric IP addresses. When a user types a domain name into a browser, the DNS server is queried to resolve (translate) that name into the corresponding IP address.

DNS operates at the Application Layer (Layer 7) of the OSI model and uses the UDP protocol on port 53.

DNS is a critical part of modern networking and internet functionality, and securing DNS through methods like **DNSSEC** is essential for preventing cyber threats such as DNS spoofing and phishing attacks.

CONCLUSION

In today's highly connected digital world, **network and security** play a crucial role in ensuring seamless communication, efficient resource sharing, and robust protection of data across organizational systems. A well-designed network infrastructure supports connectivity and collaboration, while strong security mechanisms safeguard against unauthorized access, data breaches, and cyber threats.

As enterprises like **BHEL** continue to adopt advanced technologies, maintaining secure and reliable network systems becomes essential for operational efficiency, data privacy,

and business continuity. Therefore, understanding the principles of networking and implementing effective security practices is fundamental in managing modern IT environments.

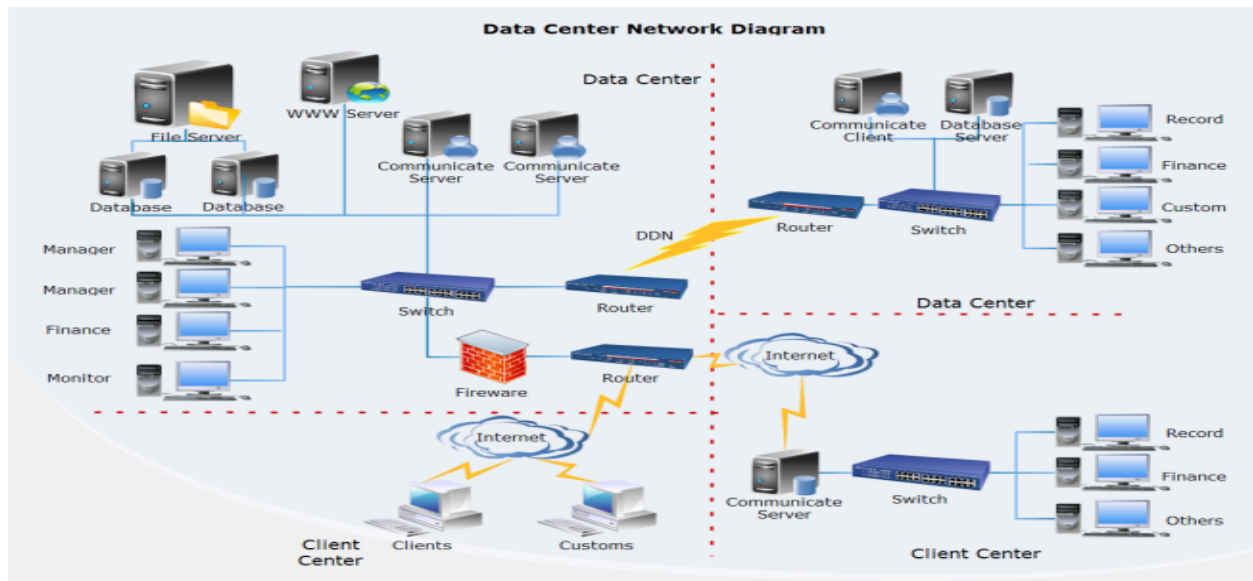


Fig- Network and Server Arrangement

SECURITY

INTRODUCTION

Security is the first priority in BHEL to counter the increasing Cyber attacks and avoid the anonymous intrusion from unauthorized elements. Various security measures are taken to match the cutting edge technology and secure the **BHELs** parameter. Firewalls, VLANs, DMZ, Anti-Virus, IPS, LLB etc. are implemented here.

LLB

Link load balancing distributes network traffic across multiple links to optimize utilization and prevent congestion. This enhances reliability and performance by ensuring no single link is overwhelmed.

Techniques include distributing traffic based on load, round-robin, or dynamically adjusting based on link conditions. Load balancing is crucial for high-availability networks, providing efficient resource utilization and minimizing downtime.

It can improve quality of service (QoS) with priority-based queuing, traffic policing and shaping.

FIREWALL

A **firewall** is a security system that monitors and controls network traffic based on a set of security rules. Firewalls usually sit between a trusted network and an untrusted network; oftentimes the untrusted network is the Internet.

In BHEL, we use Cisco , Fortinet.

Firewall creates 3 zones in a network which are public network/Internet, DMZ and private network.

In the public network the whole Internet can access the BHEL public webpage and sites. It is the most vulnerable part where security is 0%. In the Demilitarized Zone

(DMZ) we have an Email server and Web server which is in between public and private networks (LAN). It is half secure where security is 50%.

In a private network (LAN) whole Intranet and internal sites work for the company employees. It is expected to be 100% secure from external attacks.

ANTI - VIRUS

Anti-Virus is last stage security for the undetected threats from the Internet and it also secures the network from the employee side by blocking the external devices and ports which makes the whole network Zero-Trust Architecture.

CONCLUSION

In the digital age, **security** is a fundamental aspect of every IT system, ensuring the **confidentiality, integrity, and availability** of data. With rising cyber threats, implementing strong security measures like firewalls, encryption, access control, and regular monitoring is essential to protect sensitive information and maintain trust in any organization.

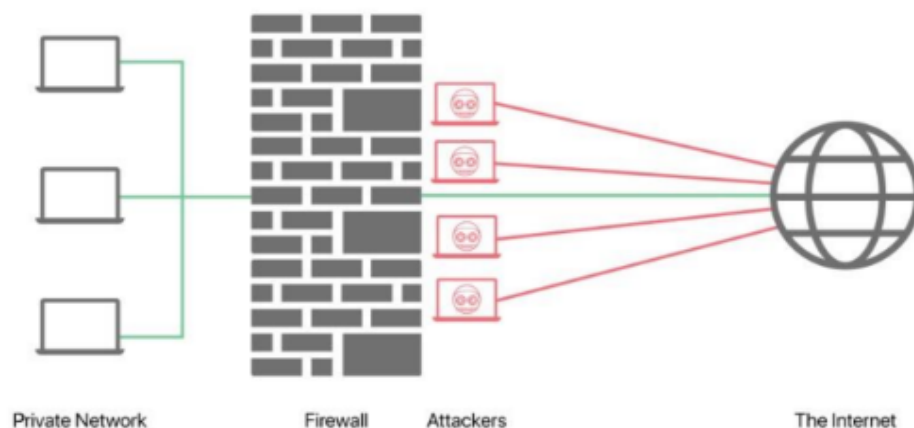


Fig- Network Security Procedure

VIDEO CONFERENCE

INTRODUCTION

Video conferencing is a technology facilitating real-time audio and video communication between BHEL employees, Directors and Investors in different locations.

In BHEL, it fosters global collaboration, saving on travel costs and promoting time efficiency. It enhances communication through visual cues, aiding in more effective discussions. The flexibility of joining meetings from various devices ensures accessibility for stakeholders worldwide.

Video conferencing is an integral part of daily working to increase productivity, providing a dynamic platform for virtual meetings, training sessions, and collaborative efforts, ultimately improving overall efficiency, reducing operational costs, and accommodating the diverse group of employees spread all over the world.

HARDWARE COMPONENTS

1. Camera:

It captures and transmits participants' video, enabling face-to-face communication. This enhances engagement, visual collaboration, and overall communication effectiveness during virtual meetings and conferences. Eg.: Polycam, Cisco

2. Codec:

It is a hardware or software-based process for encoding and decoding large chunks of audio and visual information. The codec encodes the signal for data transmission and the decoder converts and expands the signal into audio and video that can be played when received. The codec is the heart of the video conferencing system and compresses and decompresses data. Codec can control room devices using IP as login. Eg.: Cisco

3. Video Wall:

A video wall in video conferencing is a large display made up of multiple screens arranged in a grid. It provides an immersive visual experience by showcasing multiple

video feeds simultaneously, allowing participants to see remote colleagues, shared content, and presentations in a dynamic and impactful way. Video walls enhance the collaboration and engagement aspects of video conferencing. Eg.: Delta

4. Projector:

The projector displays video conference content on a large screen or surface. It is often used to share presentations, documents, or video feeds with a larger audience in a conference room or meeting space. The projector takes the video output from the codec and projects it onto a screen, allowing participants in the room to view the content collectively. Eg.: Epson

SETUP

In BHEL for VC, MS Teams are used in which meeting rooms are created and to join their unique call number is generated. Call numbers are provided to the related members. Multiple Screens are present in the room for better presentation. Sound tracking Cameras are here to focus on a particular person in the room.

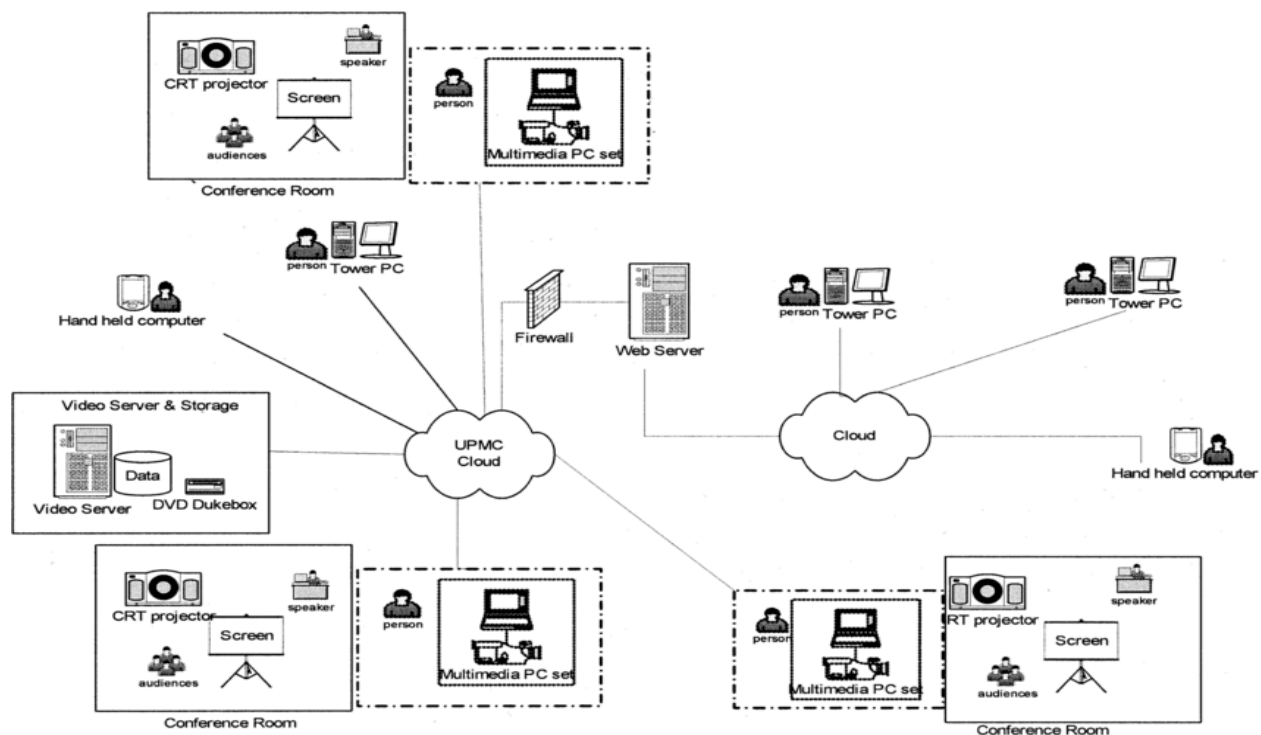


Fig- Video Conference Setup

CONCLUSION

Video conferencing has become an integral part of communication within **BHEL**, enabling seamless collaboration between various units, departments, and project sites across the country. It reduces the need for physical meetings, saves time and travel costs, and ensures quick decision-making through real-time interaction. By adopting secure and reliable video conferencing solutions, BHEL enhances its operational efficiency, supports remote coordination, and aligns with modern digital workplace practices.