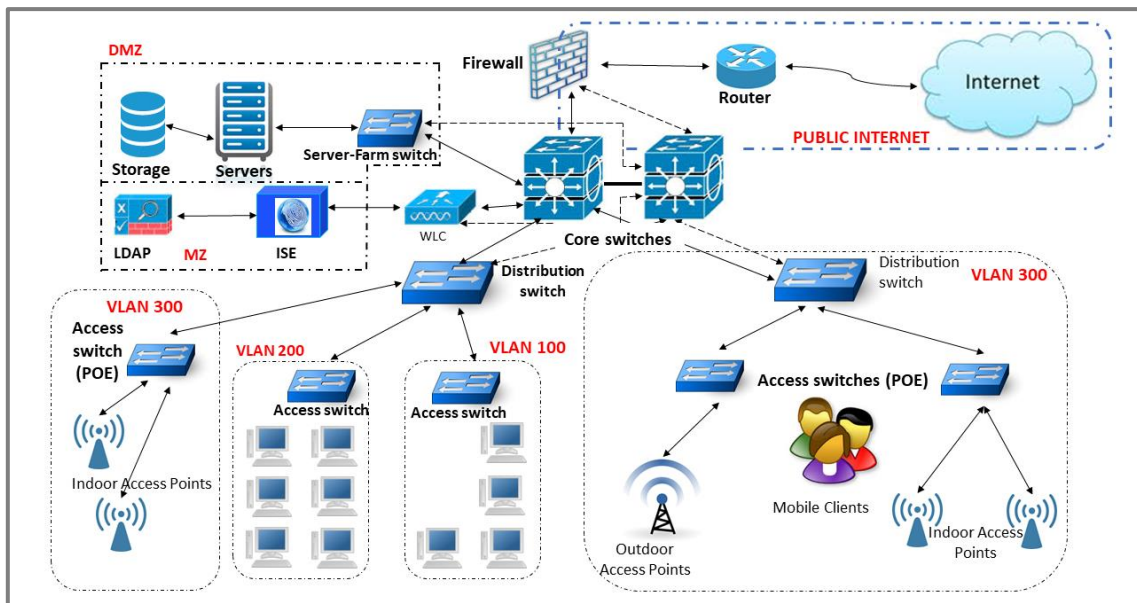


Virtual **Network Laboratory**

A Virtual Experiment on Configuration of

MULTIPLE VIRTUAL LAN (VLAN)



Instruction Manual

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SECTION 1

BASIC CONCEPT OF VLAN

1.1 VLAN

Virtual Local Area Network (VLAN) plays a vital role in the today's modern computer networks. In any of the shared ICT infrastructure such as Network Operation Centre (NOC) or Data Centre (DC) VLAN has immense significance not only in day -to-day operation but also in its maintenance and management of the overall infrastructure.

A virtual Local Area Network commonly known as (VLAN) is any broadcast domain that is partitioned and isolated in a computer network at the data link layer generally identified as layer 2 in OSI reference Model. VLANs allow network administrators to group hosts together even if the hosts are not directly connected to the same network switch.

You can see in figure 1 that there are 3 departments namely, Sales, HR and Engineering. These are logical groups connecting several nodes spread across the various switches. However, respective departmental nodes are only connected providing more security and at the same time segmenting the traffic across the VLANs.

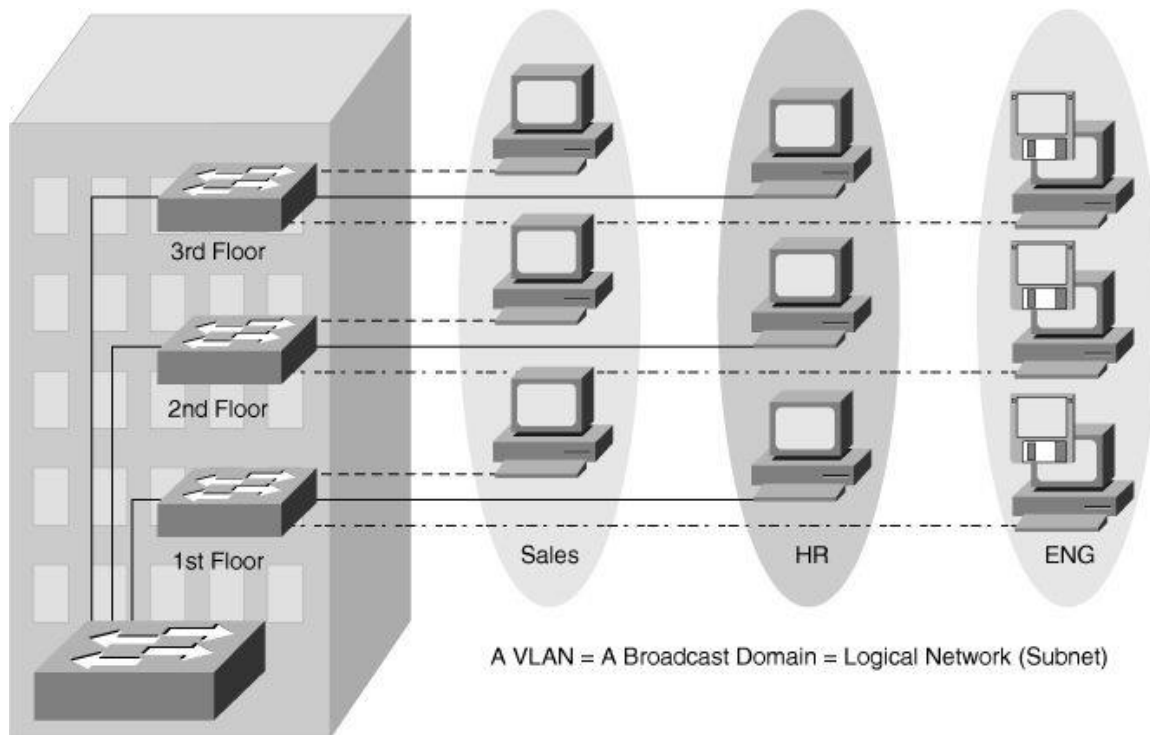


Figure 1: Multiple VLAN in an Enterprise Network

1.2 Enterprise LAN Set-up

VLAN has a significant role in the enterprise LAN setup. In the enterprises LAN not only the traffic in the LAN is segmented using VLAN. But the entire LAN is divided into four zones namely Public Internet, DMZ, MZ and LAN, which is given here in figure 2.

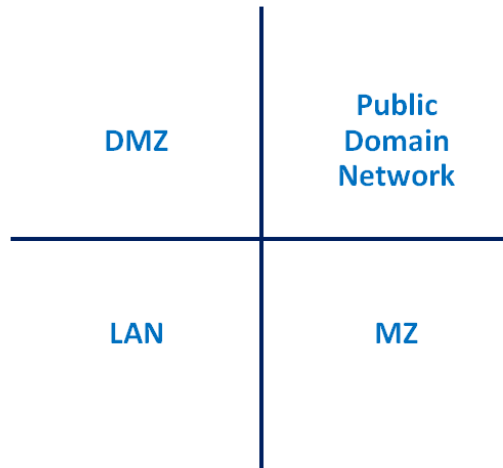


Figure 2: Multiple Zones in IT infrastructure created using VLAN.

The Zone MANAGEMENT and VLAN Routing Policy is given in figure 3, where all the Internet Connectivity is at the gateway level is fetch to the Public Internet Zone (Zone 1) using a router or a firewall. Next using the technique of Network Address Translation, we say in short (NAT) the connectivity is passed on to Demilitarized Zone, we called it as DMZ (Zone 2). DMZ host all the servers that requires protection from outside connectivity but at the same time required to stay connected to the Internet. The Militarized Zone as we call it as MZ (Zone 3) is mostly required by the administrators and can be access from the Internal Network only . Storage generally uses a separate VLAN given as Zone 4 in the figure. LAN VLAN is used for end user connectivity and can have multiple VLAN in that zone. LAN zone is depicted using Zone 5. And last but not the least guests are put through zone 6.

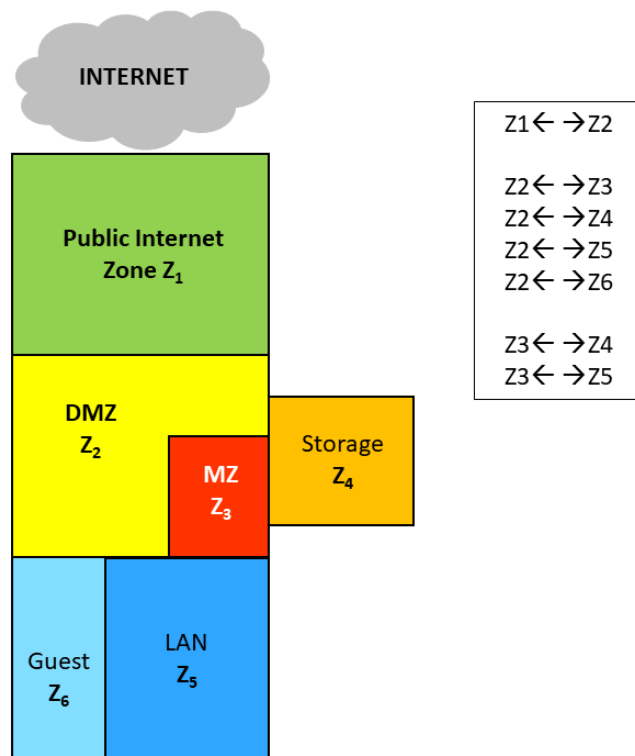


Figure 3: Zone Management and VLAN Routing policy.

1.3 Shared ICT infrastructure

In this section you can now visualize how a shared ICT infrastructure works that is given figure 4. Here PUBLIC Internet, DMZ, MZ and Local networks are clearly visible. The entire setup is managed using a Firewall where rules are configured to manage the zones.

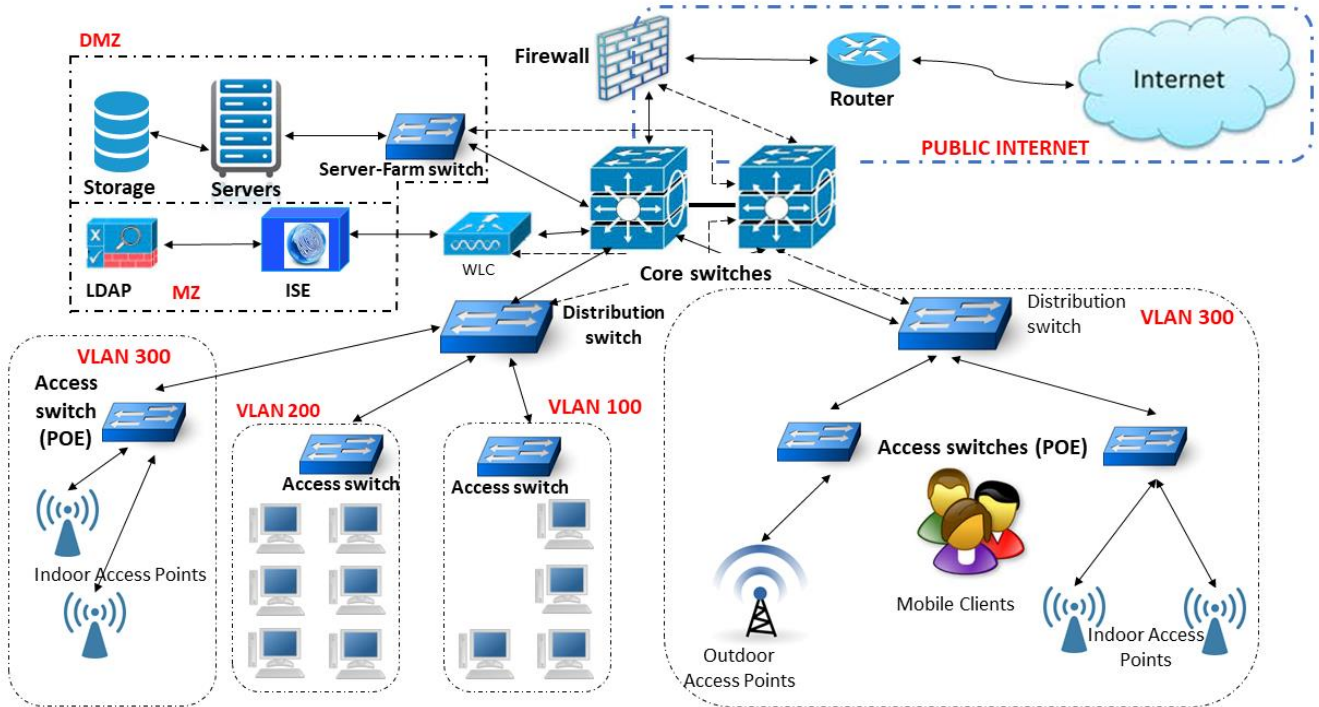


Fig 4: Shared ICT Infrastructure

It is expected that by now the learners have understood the role of VLAN in a shared ICT Infrastructure. In the next section we will see the aim of the experiment.

SECTION 2

AIM OF THE EXPERIMENT

- The aim of the experiment is to configure multiple VLANs in a single MANAGED switch.

Here in this experiment, we are going to configure three VLANs with VLAN ID 10, 20 and 30 along with names SALES, HR, ENG., respectively.

SECTION 3

ABOUT THE EXPERIMENT

Here we are going to exhibit a virtual experiment on configuration of multiple VLAN in a switch. For this purpose, we have selected three VLAN namely Sales, HR and Engg. The details of the VLANs with IP addresses are given in the table 1. The WAN VLAN is used for uplink to Firewall or Router.

Table 1: Details of the VLANs in a Managed Switch

Sl. No.	VLAN ID	VLAN Name	IP Address / Subnet Mask Address	DHCP	Excluded Address
1.	VLAN 10	Sales	172.16.32.1 / 255.255.255.0	DHCP Deployed	172.16.32.1-172.16.32.10
2.	VLAN 20	HR	172.16.34.1 / 255.255.255.0	DHCP Deployed	172.16.34.1-172.16.34.15
3.	VLAN 30	Engg	172.16.36.1 / 255.255.255.0	DHCP Deployed	172.16.36.1-172.16.36.20
4.	VLAN 40	WAN	192.168.100.3 / 255.255.255.240	NO DHCP	-

The details of the configuration for individual VLAN that are shown in the table 1 is given in section 6.

SECTION 4

STEPS TO CONFIGURE MULTIPLE VLANs

In order to carry out this virtual experiment for implementation of multiple VLAN, let us first understand what are the steps that are required to configure a VLAN in a switch. Learners, now we will see what are the activities that are required stepwise to configure multiple VLANs in a switch. We configure multiple VLANs in the identical manner. Before we proceed it is very relevant to tell you that each switch will have a default VLAN with VLAN ID as 1 as factory setup. Each VLAN you configure will have a designated VLAN ID from 2 – 4094 as VLAN ID 1 is the default ID. To configure a VLAN the following steps are required:

- **Creating a VLAN with VLAN ID**
- **Providing a Name to the VLAN**
- **Assigning ports or interfaces to respective VLAN**
- **Making the Port as access or trunk port**
- **Providing an IP Address to VLAN**
- **Creating DHCP pool for individual VLAN (if required)**
- **Exempting IP Addresses for each DHCP Pool.**

We can use the Command Line Interface (CLI) using PUTTY or HyperTerminal software to perform the configuration. The details of the CLI in stepwise manner are given in section 6.

We will follow these steps in similar manner for configuring multiple VLAN in a switch or across a set of switches.

SECTION 5

EQUIPMENT REQUIRED FOR THE EXPERIMENT

In order to carry out this virtual experiment of implementation of multiple VLAN in the actual laboratory the following equipment are required.

- **Managed Switch (1 Nos.)**
- **Laptop or Desktop (1 No.)**
- **Console Cable (1 No.) with Comm. to USB converter in case you are using a Laptop, or**
- **Mini console cable with USB Connector.**

Here in this experiment, we are using a CISCO Make Layer 2 Switch. The Model we are using here is Catalyst 9200L. This switch has 24 Gigabit Ethernet Ports (interfaces) and 4x10 Gig Ports. The switch contains redundant power supply. Figure 5 shows Cisco Catalyst 9200L Managed Switch.



Fig. 5: Cisco 9200L Managed Switch

SECTION 6

CONFIGURATION OF THE DEVICE(S)

6.1 Accessing the switch through Command Line interface (CLI)

In order to configure the switch available here, first of all we have to procure HyperTerminal software, or we can use putty software. Here we will be using the putty software. You can download putty.exe from the internet. The webpage along with URL is given in figure 6.

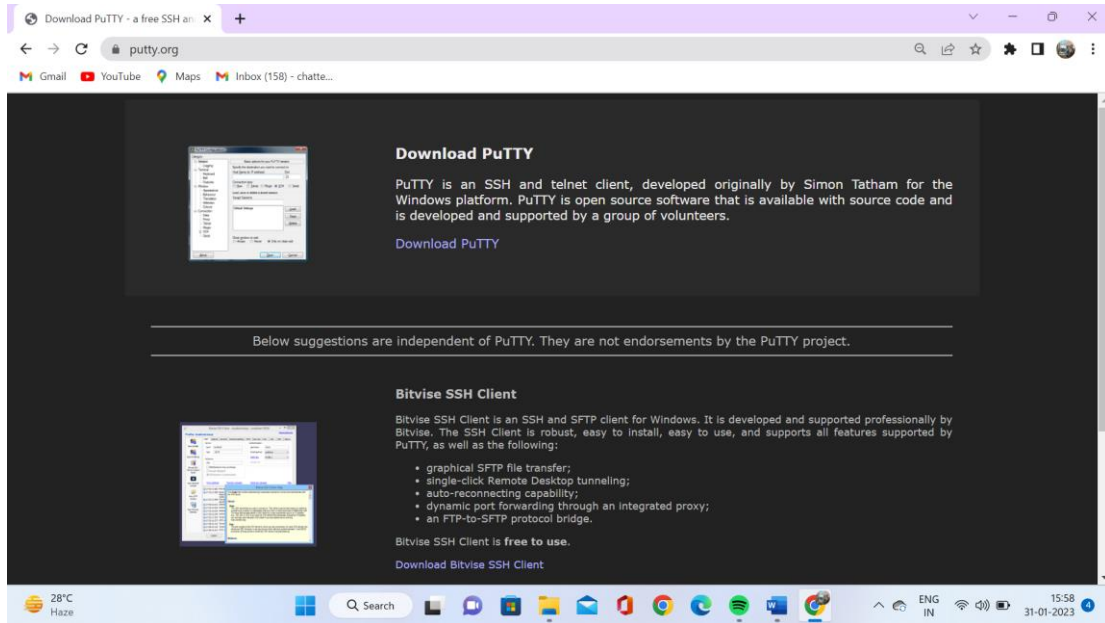


Fig 6: Webpage from where putty can be downloaded (<https://www.putty.org>)

Once the putty is downloaded from the Internet and installed click on the putty and select the serial option. Make serial line as COM5 and speed as 9600 bytes as shown in figure 7.

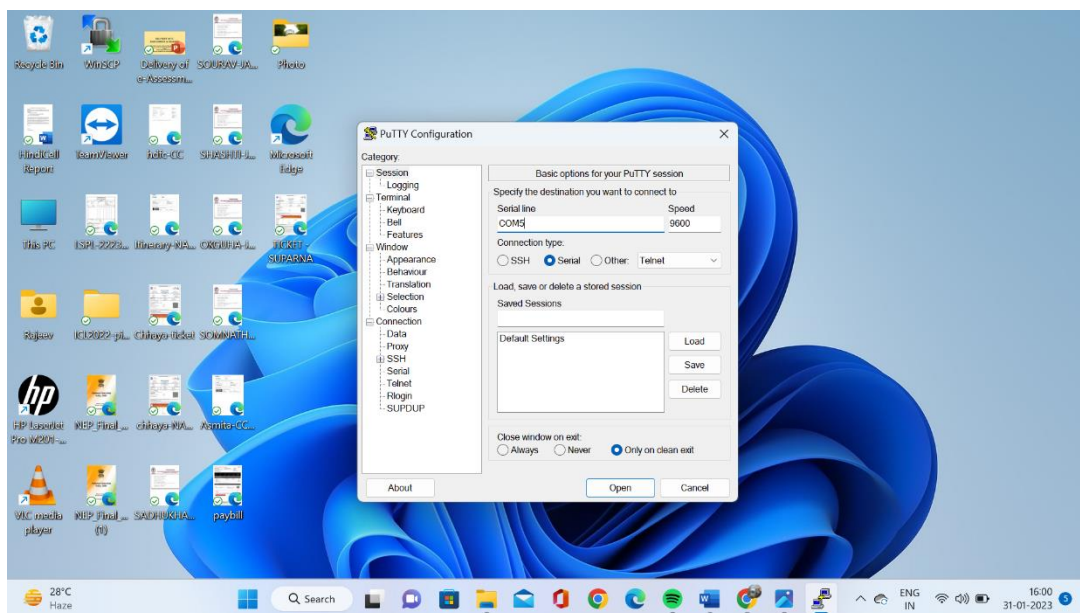
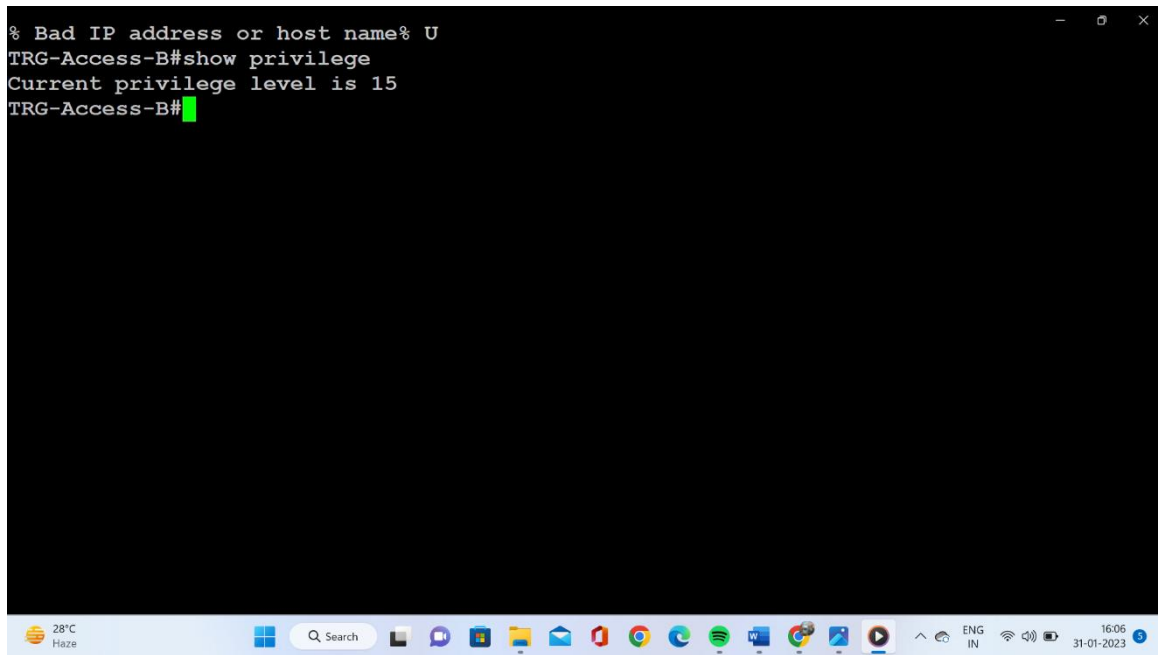


Fig 7: Interface of PUTTY software

After that the Command Line Interface (CLI) of the putty will be available as given in figure 8.



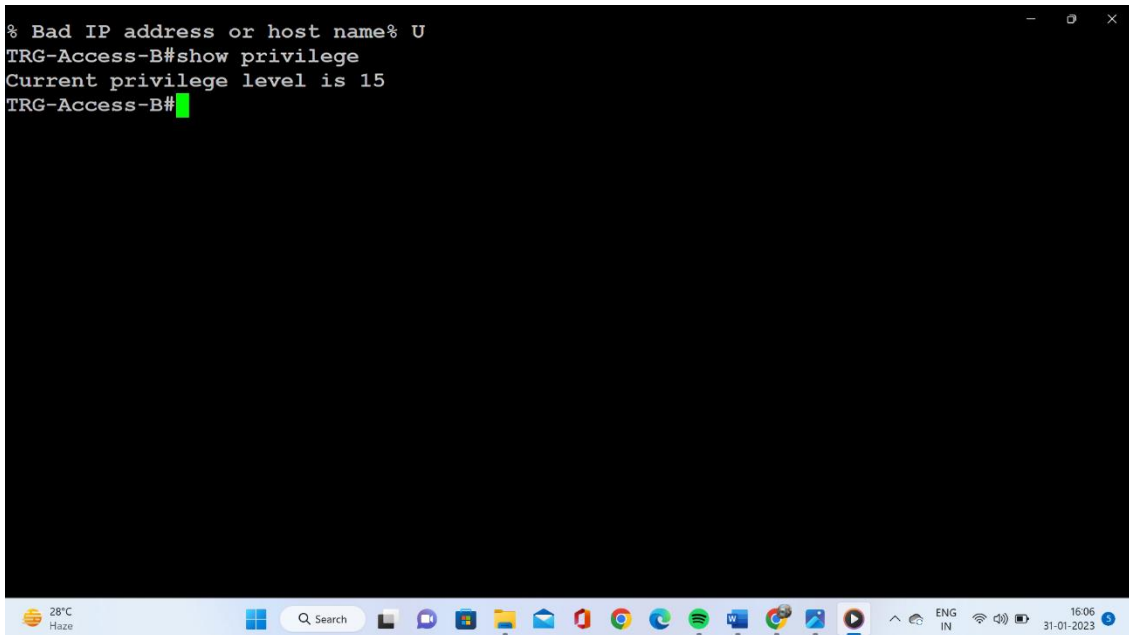
```
% Bad IP address or host name% U
TRG-Access-B#show privilege
Current privilege level is 15
TRG-Access-B#
```

Fig 8: Command Line Interface (CLI) of PUTTY (putty.exe)

Now, we can access the switch through the software (putty.exe). In the next section we will see the basic configuration command for the switch.

6.2 Configuring the switch through CLI mode

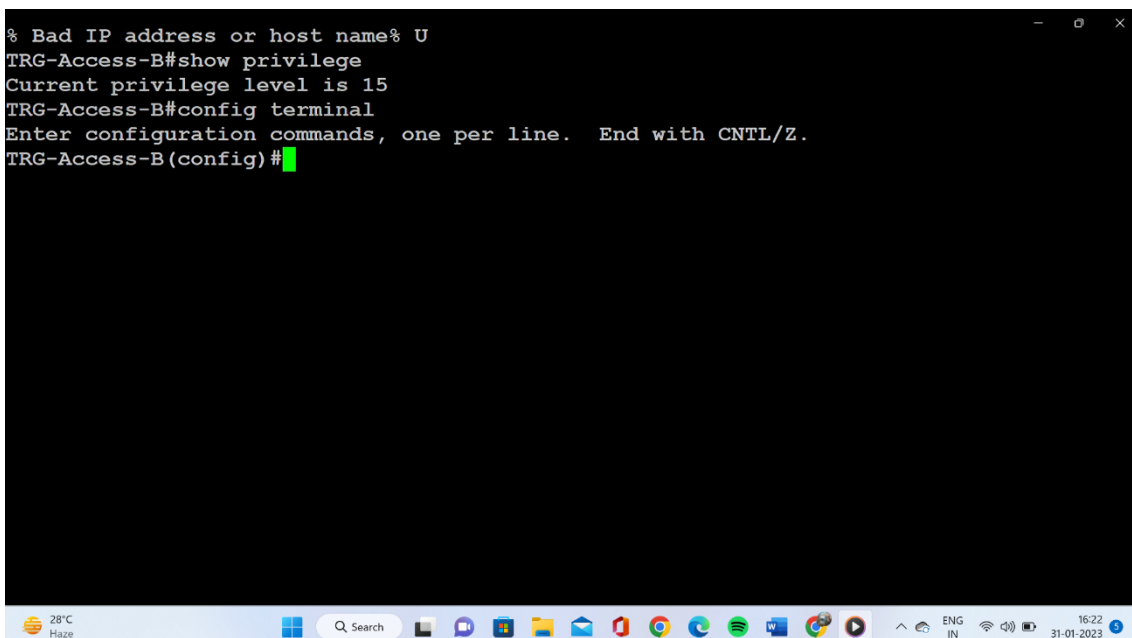
Once we login into the switch, we will check the current privilege level using the command **show privilege** as given in figure 9. The current privilege is level 15. Using this privilege, we can enter into the configuration mode.



```
% Bad IP address or host name% U
TRG-Access-B#show privilege
Current privilege level is 15
TRG-Access-B#
```

Fig 9: Shows the current privilege in the CLI.

In order to enter into the configuration mode we have to enter the command **config terminal** in the switch through the CLI. You can see that the switch is in Config mode as given in figure 10.



```
% Bad IP address or host name% U
TRG-Access-B#show privilege
Current privilege level is 15
TRG-Access-B#config terminal
Enter configuration commands, one per line. End with CNTL/Z.
TRG-Access-B(config)#
```

Fig 10: Shows how to enter Configuration mode of a Switch.

Now you can enter VLAN Configuration Command for the switch. The entire configuration for Individual VLAN is given in section 5.3.

6.3 VLAN Configuration for the Switch

VLAN Configuration for VLAN 10 with VLAN Name as SALES

```
COM5-Putty

Switch# config terminal
Switch(config)#hostname Switch-B
Switch-B(config)# vlan 010
Switch-B (config-vlan)# name SALES
Switch-B (config-vlan)# exit
Switch-B (config)# interface vlan 10
Switch-B (config-if)# ip address 172.16.32.1 255.255.255.0
Switch-B (config-if)# exit
Switch-B (config)# exit
Switch-B # exit
```

VLAN Configuration for VLAN 20 VLAN Name as HR

```
COM5-Putty

Switch-B # config terminal
Switch-B(config)# vlan 020
Switch-B (config-vlan)# name HR
Switch-B (config-vlan)# exit
Switch-B (config)# interface vlan 20
Switch-B (config-if)# ip address 172.16.34.1 255.255.255.0
Switch-B (config-if)# exit
Switch-B (config)# exit
Switch-B # exit
```

VLAN Configuration for VLAN 30 VLAN Name as ENG

COM5-Putty
Switch-B # config terminal Switch-B(config)# vlan 030 Switch-B (config-vlan)# name ENG Switch-B (config-vlan)# exit Switch-B (config)# interface vlan 30 Switch-B (config-if)# ip address 172.16.36.1 255.255.255.0 Switch-B (config-if)# exit Switch-B (config)# exit Switch-B # exit

VLAN Configuration for VLAN 40 VLAN Name as WAN

COM5-Putty
Switch-B # config terminal Switch-B(config)# vlan 040 Switch-B (config-vlan)# name WAN Switch-B (config-vlan)# exit Switch-B (config)# interface vlan 40 Switch-B (config-if)# ip address 192.168.100.3 255.255.255.240 Switch-B (config-if)# exit Switch-B (config)# exit Switch-B # exit

6.4 Assigning ports or interfaces to the respective VLAN

a) Assigning a single port or Interface to VLAN 10, VLAN 20 and VLAN 30 having Access Mode one by one.

```
COM5-Putty

Switch-B # config terminal
Switch-B(config)# interface gigabitEthernet 1/0/5
Switch-B (config-if)# switchport access vlan 10
Switch-B (config-if)# switchport mode access
Switch-B (config-if)# exit
Switch-B(config)# interface gigabitEthernet 1/0/6
Switch-B (config-if)# switchport access vlan 20
Switch-B (config-if)# switchport mode access
Switch-B (config-if)# exit
Switch-B(config)# interface gigabitEthernet 1/0/7
Switch-B (config-if)# switchport access vlan 30
Switch-B (config-if)# switchport mode access
Switch-B (config)# exit
Switch-B #
```

b) Assigning a range of ports or Interfaces to VLAN 20 having Access Mode.

```
COM5-Putty

Switch-B # config terminal
Switch-B(config)# interface range gigabitEthernet 1/0/11-15
Switch-B (config-if-range)# switchport access vlan 20
Switch-B (config-if-range)# switchport mode access
Switch-B (config-if-range)# exit
Switch-B (config)# exit
Switch-B #
```

c) Making a port or Interface to as Trunk Port.

```
COM5-Putty

Switch-B # config terminal
Switch-B(config)# interface gigabitEthernet 1/0/1
Switch-B (config-if)# switchport mode trunk
Switch-B (config-if)# exit
Switch-B (config)# exit
Switch-B #
```

6.5 DHCP Configuration (IPv4) for Individual VLAN

DHCP Configuration for VLAN 10.

```
COM5-Putty

Switch-B # config terminal
Switch-B(config)# ip dhcp pool vlan 10
Switch-B (config-dhcp)# network 172.16.32.0 255.255.255.0
Switch-B (config-dhcp)# default-router 172.16.32.1
Switch-B (config-dhcp)# dns-server 8.8.8.8
Switch-B (config-dhcp)# dns-server 4.2.2.2
Switch-B (config-dhcp)# exit
Switch-B (config)# exit
Switch-B #
```


DHCP Configuration for VLAN 20.

```
COM5-Putty

Switch-B # config terminal
Switch-B(config)# ip dhcp pool vlan 20
Switch-B (config-dhcp)# network 172.16.34.0 255.255.255.0
Switch-B (config-dhcp)# default-router 172.16.34.1
Switch-B (config-dhcp)# dns-server 8.8.8.8
Switch-B (config-dhcp)# dns-server 4.2.2.2
Switch-B (config-dhcp)# exit
Switch-B (config)# exit
Switch-B #
```

DHCP Configuration for VLAN 30 .

```
COM5-Putty

Switch-B # config terminal
Switch-B(config)# ip dhcp pool vlan 30
Switch-B (config-dhcp)# network 172.16.36.0 255.255.255.0
Switch-B (config-dhcp)# default-router 172.16.36.1
Switch-B (config-dhcp)# dns-server 8.8.8.8
Switch-B (config-dhcp)# dns-server 4.2.2.2
Switch-B (config-dhcp)# exit
Switch-B (config)# exit
Switch-B #
```

6.6 DHCP Excluded Address for all VLANs.

```
COM5-Putty

Switch-B # config terminal
Switch-B(config)# ip dhcp excluded-address 172.16.32.1 172.16.32.10
Switch-B(config)# ip dhcp excluded-address 172.16.34.1 172.16.34.15
Switch-B(config)# ip dhcp excluded-address 172.16.36.1 172.16.36.20
Switch-B (config)# exit
Switch-B #
```

6.7 Providing Default Route for all the VLANs.

COM5-Putty
Switch-B # config terminal Switch-B(config)# ip route 0.0.0.0 0.0.0.0 192.168.100.15 Switch-B (config)# exit Switch-B #

6.8 Saving the Configuration in the Switch.

This can be done in two ways:

a) Using Copy Command

COM5-Putty
Switch-B # copy Switch-B # copy running-config startup-config Switch-B #

b) Using Write Command

COM5-Putty
Switch-B # copy Switch-B # write Switch-B #

Disclaimer: The configuration for VLANs shown in this document is based on the connection layout and deployment laid down by the instructor. There can be different way of deployment and accordingly the Configuration, IP Addresses and Networks may change. Learners' cooperation is solicited.

SECTION 6

REFERENCES

A. Reference Books

Sl. No.	Title of the Book	Author(s)	Publisher	Edition
1)	The TCP/IP Guide: A Comprehensive, Illustrated Internet Protocols Reference	Charles M. Kozierok	No Starch Press Inc.	1 st Edition, 2005
2)	Cisco IOS in a Nutshell: A Desktop Quick Reference for IOS on IP Networks	James Boney	O' Reilly	2 nd Edition August 2005
3)	Cisco Cookbook: Field-Tested Solutions to Cisco Router Problems	Kevin Dooley & Ian J. Brown	O' Reilly	1 st Edition July 2003
4)	Cisco Networking Academy's Introduction to VLANs	N.A.	Pearson Education, Cisco Press	1 st Edition April 2014

B. Online Supportive Material

Sl. No.	Title of the Book	Date of Access	Publisher
1)	Chapter 10 Understanding and Configuring VLANs https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst4500/12-2/25ew/configuration/guide/conf/vlans.pdf	Jan 31, 2023	Cisco Press

C. IETF Documents

- 1) RFC 3576
- 2) RFC 3580
- 3) RFC 3069
- 4) RFC 4675