



NTWK8141



Student Name	Harshul Shukla (Section 2)
Student ID	8986048
Deliverable	NTWK8141-Practical Assignment 2
Date Assigned	05 Nov 2024
Date Due	24 Nov 2024
Rules	• Individual. • Cheating is not allowed. • Plagiarism counts as cheating! That FAILURE to submit work in the course can result in a grade of 'F' or 'I' for failure to complete the course!

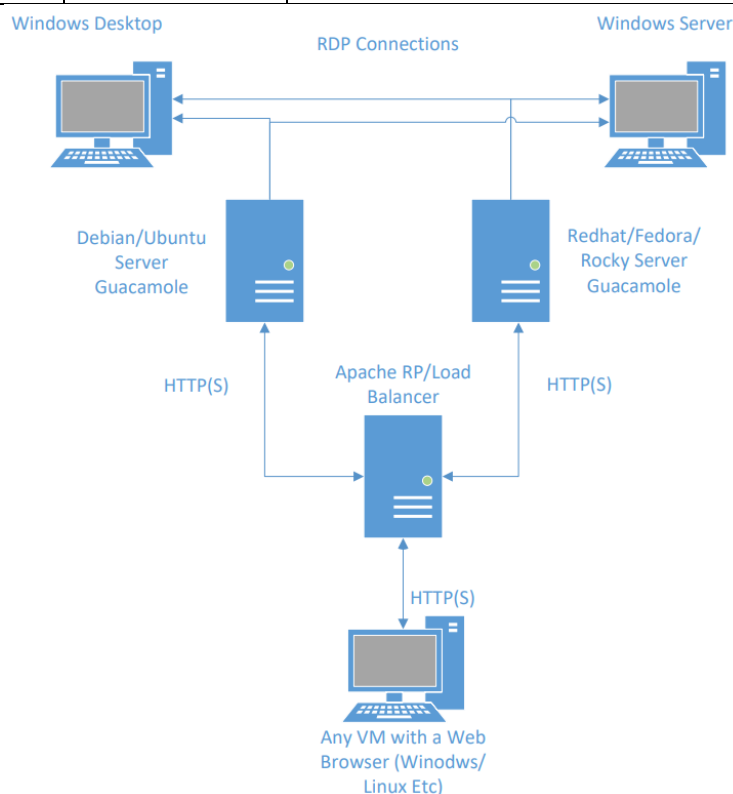
Contents

1. Introduction and Objectives	3
2. Windows Server (DC) Setup	4
3. Windows Client Setup	5
4.Steps to Join a Linux System to a Domain.....	6
5. Linux Client (SSH, SCP).....	7
6. Configuring Guacamole in Ubuntu	8
7. Configuring Guacamole in Rocky Linux.....	14
8.Loadballancer and Reverse Proxy.....	24

1. Introduction and Objectives

- **Windows DC:** A Windows Server acting as Domain Controller
- **Windows Client:** A Windows client machine configured to connect to DC using Remote Desktop Protocol
- **Linux Servers and Client:** Three Linux servers and one client (Optional) to be added to Windows domain
- **Guacamole Setup:** Deploy Guacamole on Ubuntu and Fedora servers for remote desktop access
- **Customization:** Modify Guacamole web page titles to show their OS
- **Load Balancer:** Set up load balancer to distribute traffic between Guacamole instances
- **Reverse proxy:** Set up reverse proxy for load balancer

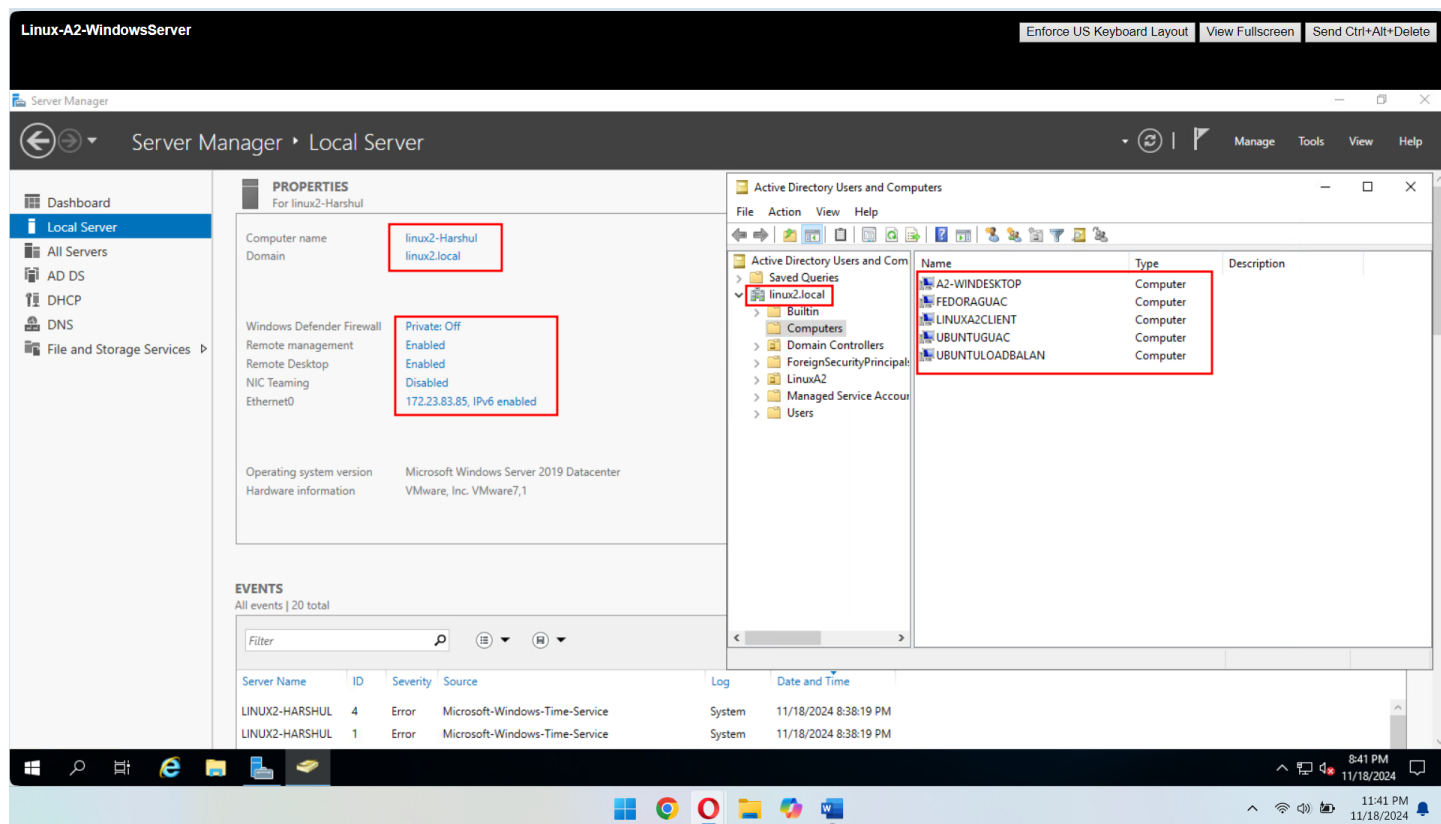
Component	IP Address	Role
Windows Server	172.23.83.85	Domain Controller (DC) for Linux2.local
Windows Client	172.23.83.86	RDP connection via Guacamole
Linux Client	172.23.83.21	SSH , SCP to servers, joined to domain
Ubuntu Server	172.23.83.87	Ubuntu-Guacamole server with usermapping.xml
Fedora Server	172.23.83.111	Rocky Linux ,Guacamole server with LDAP
Load Balancer	172.23.83.88	Apache reverse proxy with load balancing



2. Windows Server (DC) Setup

Configure the Domain and Enable RDP

1. Log in to the **Windows Server**.
2. Open **Server Manager** and install **Active Directory Domain Services (AD DS)** and **DNS Server**.
3. Promote server to a Domain Controller(DC) - Domain Name: **Linux2.local**.
4. Check if DNS is correctly configured to resolve hostnames in domain
5. Make sure remote desktop is enabled for RDP.



NOTE :

Check that all virtual machines have enough resources to operate so we are giving the following specs for each VM

- **Memory:** 3 GB
- **CPU:** 4 cores
- **Hard Drive:** 90 GB

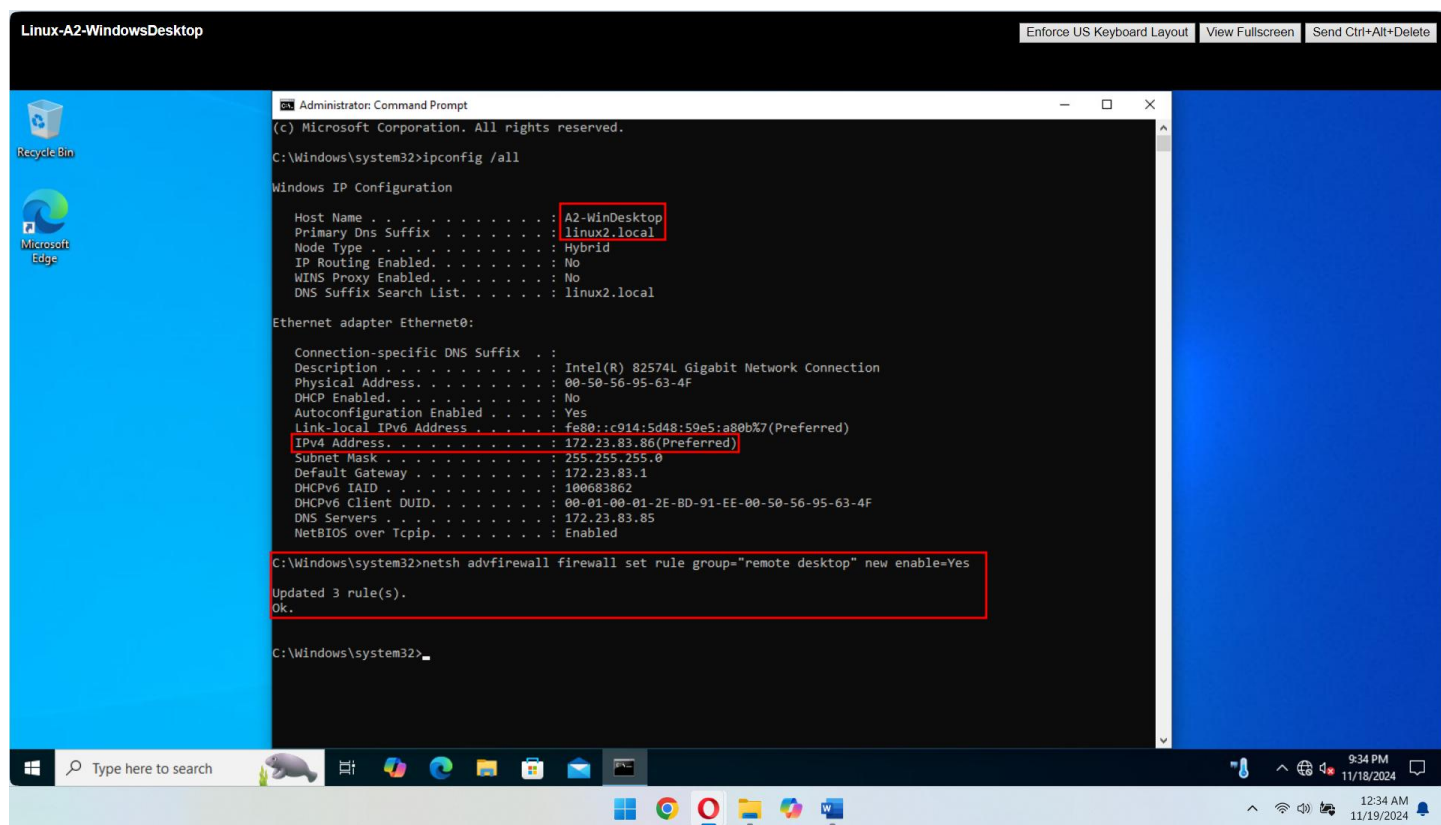
3. Windows Client Setup

Step 1: Join the Domain

1. Open **Control Panel > System > Change Settings**.
2. Under the **Computer Name** tab, click **Change**.
3. Enter the domain name: **Linux2.local**.
4. Provide the domain administrator credentials to join the domain.

Step 2: Enable RDP

1. Open **Control Panel > System and Security > System > Remote Settings**.
2. Under **Remote Desktop**, select
"Allow remote connections to this computer."
"Allow connections only from computers running Remote Desktop with Network Level Authentication."
3. Open the firewall to allow RDP traffic: Go to cmd and enter **"netsh advfirewall firewall set rule group="remote desktop" new enable=Yes"**



4. Steps to Join a Linux System to a Domain

Update Package Manager

```
sudo apt update
```

Install the packages needed for domain joining and authentication

```
sudo apt -y install realmd libnss-sss libpam-sss sssd sssd-tools adcli samba-common-bin oddjob oddjob-mkhomedir
```

Install Kerberos User Tools

```
sudo apt install krb5-user
```

Set Hostname

```
sudo hostnamectl set-hostname linux-Harshul.Linux2.local
```

Disable and Stop systemd-resolved

```
sudo systemctl disable systemd-resolved
```

```
sudo systemctl stop systemd-resolved
```

Edit DNS Resolver Configuration

Update the `/etc/resolv.conf` file with the domain's DNS server details:

```
sudo nano /etc/resolv.conf
```

Add the following lines:

```
nameserver 172.23.83.85
```

```
options edns0 trust-ad
```

```
search Linux2.local
```

Authenticate as Domain Administrator

Use kinit to authenticate with Kerberos:

```
sudo kinit Administrator@LINUX2.LOCAL
```

Join the Domain

Execute the realm command to join the domain:

```
sudo realm join -U Administrator LINUX2.LOCAL
```

Check

```
Realm list
```

Note: Use dnf instead of apt for fedora/red hat-based systems.

5. Linux Client (SSH, SCP)

Step 1: Install and Configure SSH

The same package installs both SSH and SCP

Install the SSH server on the Linux client

```
sudo apt update && sudo apt install -y openssh-server
```

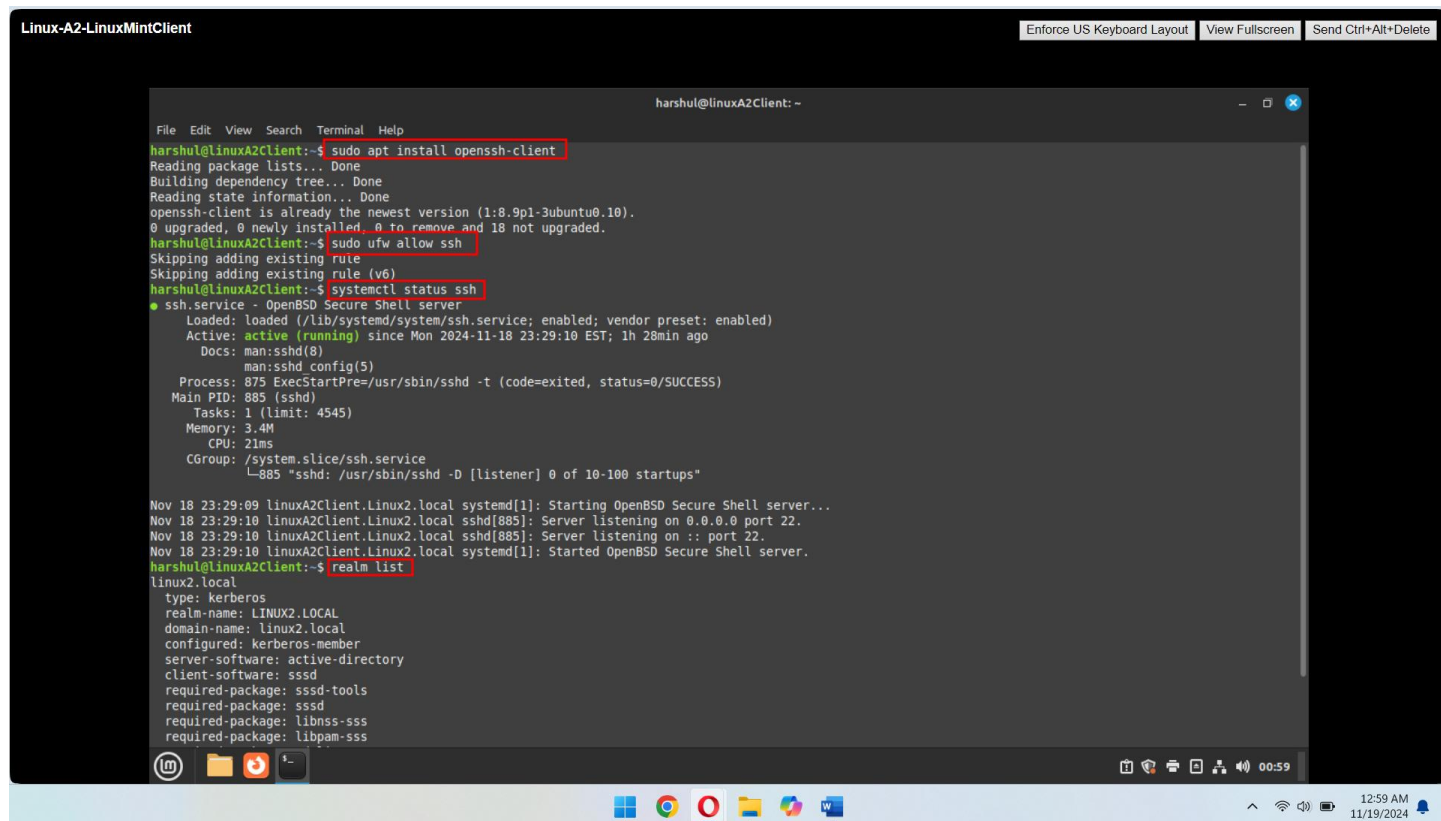
Ensure the SSH service is running

```
sudo systemctl enable ssh
```

```
sudo systemctl start ssh
```

Allow SSH through the firewall

```
sudo ufw allow ssh
```



The screenshot shows a terminal window titled "Linux-A2-LinuxMintClient" with a menu bar (File, Edit, View, Search, Terminal, Help). The user "harshul" is logged in at "linuxA2Client:~". The terminal output shows the following commands and their results:

```
harshul@linuxA2Client:~$ sudo apt install openssh-server
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
openssh-server is already the newest version (1:8.9p1-3ubuntu0.10).
0 upgraded, 0 newly installed, 0 to remove and 18 not upgraded.
harshul@linuxA2Client:~$ sudo ufw allow ssh
Skipping adding existing rule
Skipping adding existing rule (v6)
harshul@linuxA2Client:~$ systemctl status ssh
● ssh.service - OpenBSD Secure Shell server
   Loaded: loaded (/lib/systemd/system/ssh.service; enabled; vendor preset: enabled)
   Active: active (running) since Mon 2024-11-18 23:29:10 EST; 1h 28min ago
     Docs: man:sshd(8)
           man:sshd_config(5)
   Process: 875 ExecStartPre=/usr/sbin/sshd -t (code=exited, status=0/SUCCESS)
    Main PID: 885 (sshd)
      Tasks: 1 (limit: 4545)
     Memory: 3.4M
        CPU: 21ms
   CGroup: /system.slice/ssh.service
           └─885 "sshd: /usr/sbin/sshd -D [listener] 0 of 10-100 startups"

Nov 18 23:29:09 linuxA2Client.Linux2.local systemd[1]: Starting OpenBSD Secure Shell server...
Nov 18 23:29:10 linuxA2Client.Linux2.local sshd[885]: Server listening on 0.0.0.0 port 22.
Nov 18 23:29:10 linuxA2Client.Linux2.local sshd[885]: Server listening on :: port 22.
Nov 18 23:29:10 linuxA2Client.Linux2.local systemd[1]: Started OpenBSD Secure Shell server.
harshul@linuxA2Client:~$ realm list
linux2.local
type: kerberos
realm-name: LINUX2.LOCAL
domain-name: linux2.local
configured: kerberos-member
server-software: active-directory
client-software: sssd
required-package: sssd-tools
required-package: sssd
required-package: libnss-sss
required-package: libpam-sss
```

The terminal window is running on a Linux desktop environment, with the system clock showing 12:59 AM on 11/19/2024.

6. Configuring Guacamole in Ubuntu

Once you join the domain Linux2.local , we can proceed with the configuring the Guacamole in ubuntu server, make sure to follow the steps:

Make sure to update and install all necessary packages and dependencies:

Update Package Lists: `sudo apt update`

Upgrade Installed Packages: `sudo apt upgrade`

Install Required Dependencies:

`sudo apt install build-essential libcairo2-dev libjpeg-turbo8-dev libpng-dev libtool-bin libosspp-uuid-dev libvncserver-dev freerdp2-dev libssh2-1-dev libtelnet-dev libwebsockets-dev libpulse-dev libvorbis-dev libwebp-dev libssl-dev libpangol.0-dev libswscale-dev libavcodec-dev libavutil-dev libavformat-dev -y`

Download the tar file directly or download from linux client and send via SSH and proceed to unzip it

`Ssh guacamole-server-1.4.0.tar harshul@172.23.83.87:~`

Once Download is complete Unzip the file and go to that folder and then we can install and proceed.

Extract the Tar File: `tar -xzf guacamole-server-1.4.0.tar.gz`

Navigate to the Extracted Directory: `cd guacamole-server-1.4.0/`

Configure the Build Environment: `./configure --with-init-dir=/etc/init.d`

Compile the Source Code: `sudo make`

Install Guacamole Server: `sudo make install`

Updating system cache

Update System Cache: `sudo ldconfig`

Reload Systemd Daemon: `sudo systemctl daemon-reload`

Enable Guacamole Daemon guacd to Start at Boot: `sudo systemctl enable guacd`

Start Guacamole Daemon: `sudo systemctl start guacd`

Note: Make sure all the dependencies are installed correctly and not missing anything for guacamole to run properly.

Verify status

sudo systemctl status guacd

```

Linux-A2-LinuxMintClient
Enforce US Keyboard Layout View Fullscreen Send Ctrl+Alt+Delete

harshul@ubuntu:~$ systemctl status guacd.service
● guacd.service - Guacamole proxy daemon
   Loaded: loaded (/lib/systemd/system/guacd.service; enabled; vendor preset: enabled)
   Active: active (running) since Wed 2024-11-20 12:02:11 UTC; 1 day 1h ago
     Docs: man:guacd(8)
   Process: 813 ExecStart=/usr/sbin/guacd $DAEMON_ARGS -b $LISTEN_ADDRESS -l $LISTEN_PORT -p /var/run/guacd/guacd.pid (code=exited, status=0/SUCCESS)
   Main PID: 940 (guacd)
     Tasks: 1 (limit: 4563)
    Memory: 11.0M
       CPU: 3.101s
   CGroup: /system.slice/guacd.service
           └─940 /usr/sbin/guacd -b 127.0.0.1 -l 4822 -p /var/run/guacd/guacd.pid

Nov 21 03:15:47 ubuntu:guacd.local guacd[2842]: Loading keymap "base"
Nov 21 03:15:47 ubuntu:guacd.local guacd[2842]: Loading keymap "en-us-qwerty"
Nov 21 03:15:48 ubuntu:guacd.local guacd[2842]: Connected to RDPDR 1.13 as client 0x0003
Nov 21 03:15:49 ubuntu:guacd.local guacd[2842]: Connected to RDPDR 1.13 as client 0x0002
Nov 21 03:15:49 ubuntu:guacd.local guacd[2842]: RDPDR user logged on
Nov 21 03:15:50 ubuntu:guacd.local guacd[2842]: RDP server closed/refused connection: Manually disconnected.
Nov 21 03:15:50 ubuntu:guacd.local guacd[2842]: Internal RDP client disconnected
Nov 21 03:15:50 ubuntu:guacd.local guacd[2842]: User "0d060d73e-6f4c-44af-bc38-f32e3b4983ce" disconnected (0 users remain)
Nov 21 03:15:50 ubuntu:guacd.local guacd[2842]: Last user of connection "$675dde94-37a0-400f-8cd7-72efa94b13dc" disconnected
Nov 21 03:15:50 ubuntu:guacd.local guacd[940]: Connection "$675dde94-37a0-400f-8cd7-72efa94b13dc" removed.
harshul@ubuntu:~$

```

Files configurations : We need to create /etc/guacamole and two more directories called lib and extensions

```

Linux-A2-LinuxMintClient
Enforce US Keyboard Layout View Fullscreen Send Ctrl+Alt+Delete

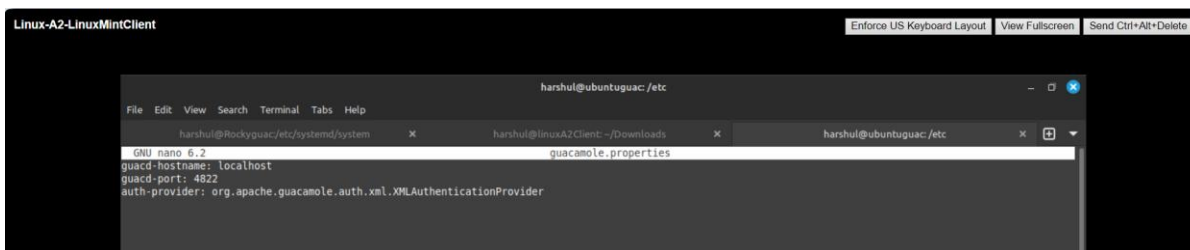
harshul@ubuntu:/etc/guacamole$ ls -l
total 12
drwxr-xr-x 2 root root 4096 Nov 13 06:08 extensions
-rw-r--r-- 1 root root   9 Nov 13 06:08 guacd.conf
drwxr-xr-x 2 root root 4096 Nov 13 06:08 lib
-rw-r--r-- 1 harshul harshul 849 Nov 15 22:14 user-mapping.xml
harshul@ubuntu:/etc/guacamole$

```

Configuring User-Mapping for Guacamole on Ubuntu

/etc/guacamole.properties file Will be updated

Open guacamole.properties : `sudo nano guacamole.properties` and enter the following as shown in image.



Update user-mapping.xml

`sudo nano /etc/guacamole/user-mapping.xml`

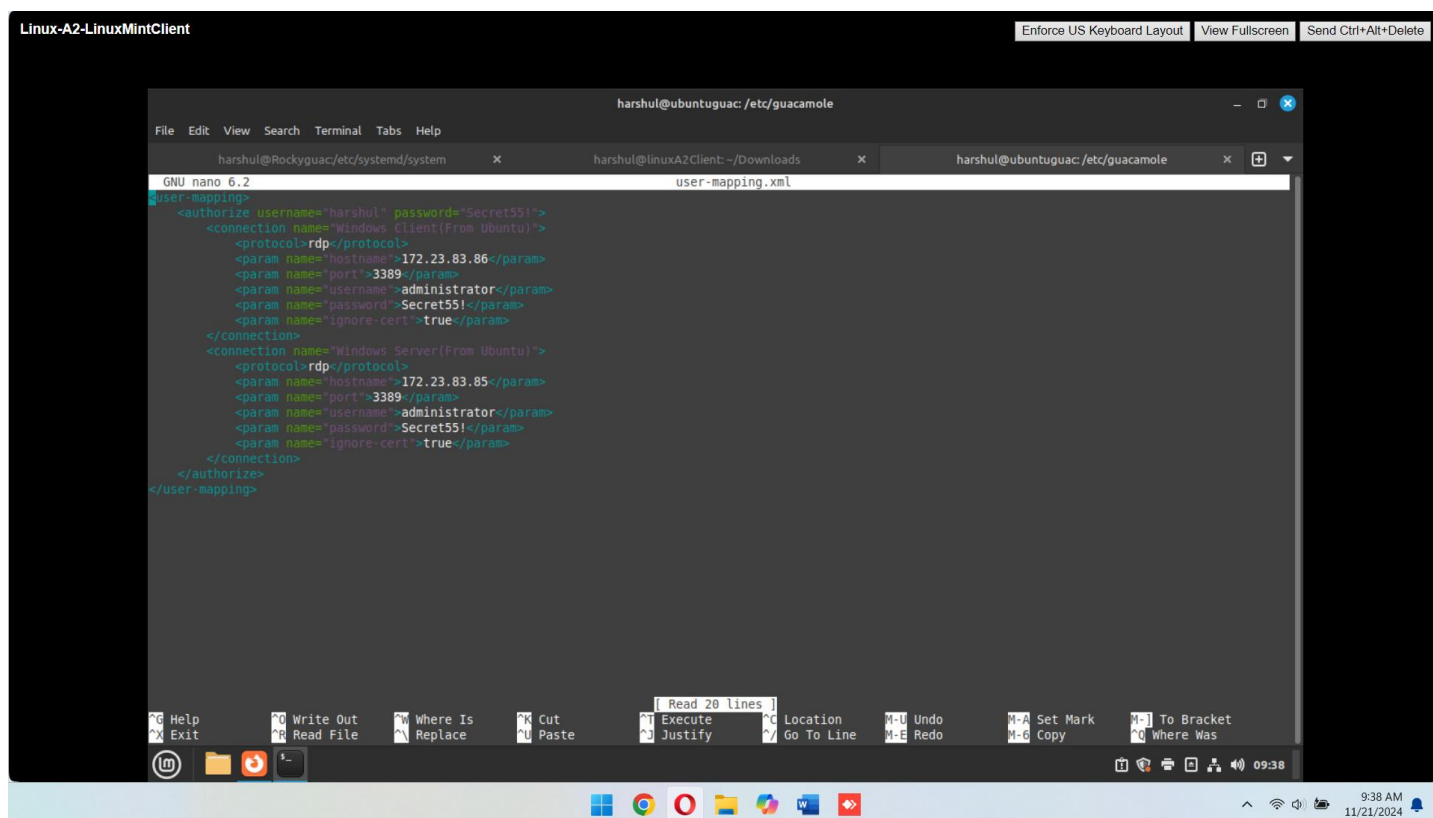
Enter the username, password, connection name, protocol, and port details without any mistakes or extra spaces. Follow the below image for proper configurations.

After entering details, save file by entering `Ctrl + O`

Exit with `Ctrl + X`.

After updating configuration files, restart Guacamole service to apply changes

`sudo systemctl restart guacd`



Changing the Web Page Appearance for Guacamole

Next step is to change the way Web page looks to differentiate between ubuntu and Rocky linux login page , so we will be making small change to make it look different. We will change en.json

Navigate to the Webapps Directory: `cd /var/lib/tomcat/webapps/`

Change Ownership of Guacamole Directory: `sudo chown harshul:harshul guacamole`

Change Ownership of Translations Directory: `sudo chown harshul:harshul translations.`

Modify en.json: Open the en.jsonFile: `sudo nano /var/lib/tomcat9/websapp/guacamole/translations/en.json`

open the file and change the name as shown in below image **New name : Harshul Ubuntu-Guacamole**

Save and Exit: `ctrl + o , ctrl + x`

The screenshot shows a terminal window titled "Linux-A2-LinuxMintClient" with a nano editor open at the file `/var/lib/tomcat9/webapps/guacamole/translations/en.json`. The file content is as follows:

```

"NAME" : "English",
"APP" : {
  "NAME" : "Harshul Ubuntu-Guacamole",
  "VERSION" : "1.4.0",
  "ACTION_AKNOWLEDGE" : "OK",
  "ACTION_CANCEL" : "Cancel",
  "ACTION_CLONE" : "Clone",
  "ACTION_CONTINUE" : "Continue",
  "ACTION_DELETE" : "Delete",
  "ACTION_DELETE_SESSIONS" : "Kill Sessions",
  "ACTION_DOWNLOAD" : "Download",
  "ACTION_LOGIN" : "Login",
  "ACTION_LOGIN_AGAIN" : "Re-login",
  "ACTION_LOGOUT" : "Logout",
  "ACTION_MANAGE_CONNECTIONS" : "Connections",
  "ACTION_MANAGE_PREFERENCES" : "Preferences",
  "ACTION_MANAGE_SETTINGS" : "Settings",
  "ACTION_MANAGE_SESSIONS" : "Active Sessions",
  "ACTION_MANAGE_USERS" : "Users",
  "ACTION_MANAGE_USER_GROUPS" : "Groups",
  "ACTION_NAVIGATE_BACK" : "Back",
  "ACTION_NAVIGATE_HOME" : "Home",
  "ACTION_SAVE" : "Save",
  "ACTION_SEARCH" : "Search",
  "ACTION_SHARE" : "Share",
  "ACTION_UPDATE_PASSWORD" : "Update Password",
  "ACTION_VIEW_HISTORY" : "History",

```

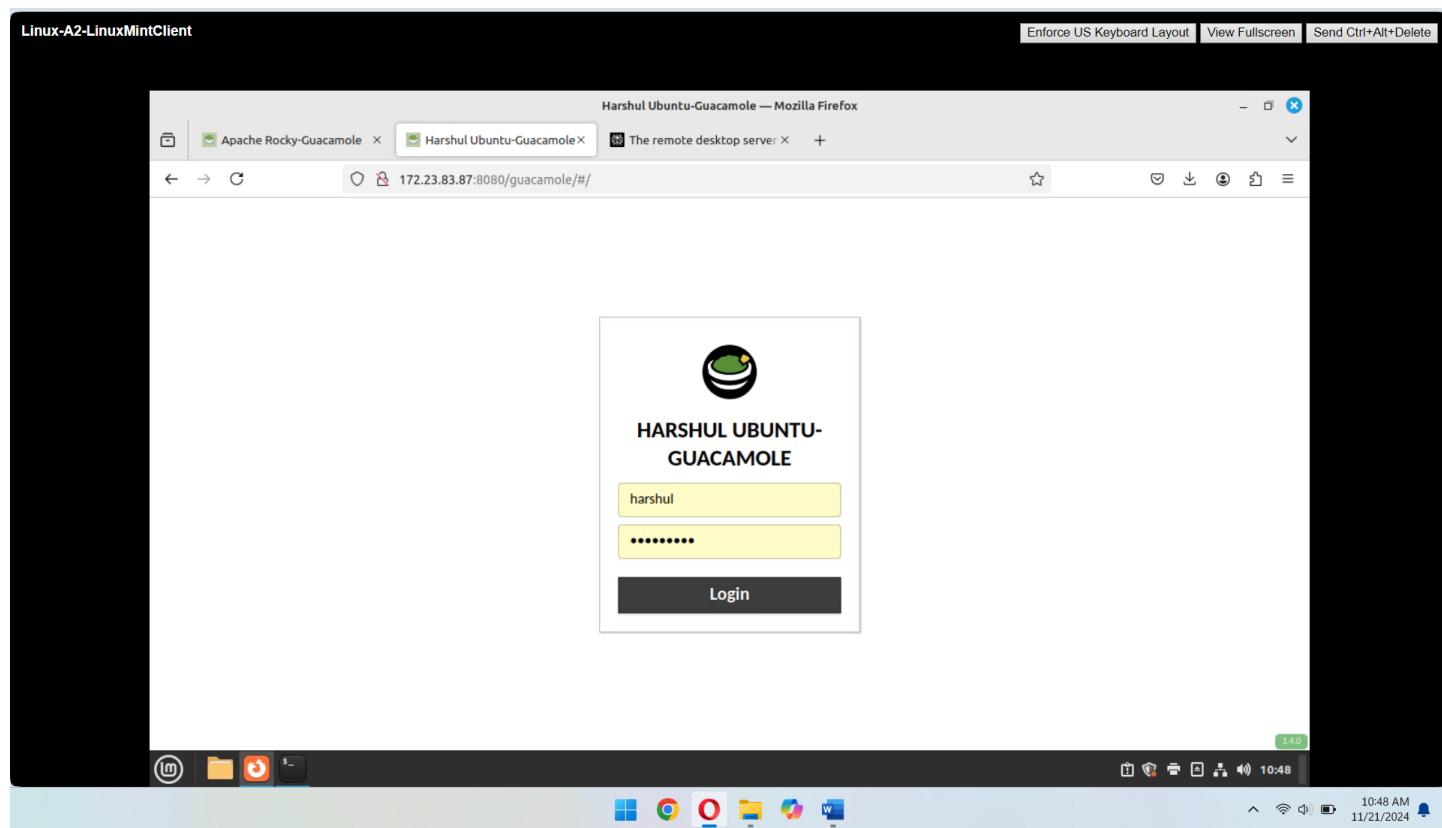
The terminal window also shows a status bar at the bottom with various keyboard shortcuts and a system tray at the bottom right indicating the time as 10:43 AM on 11/21/2024.

Restore Original Permissions

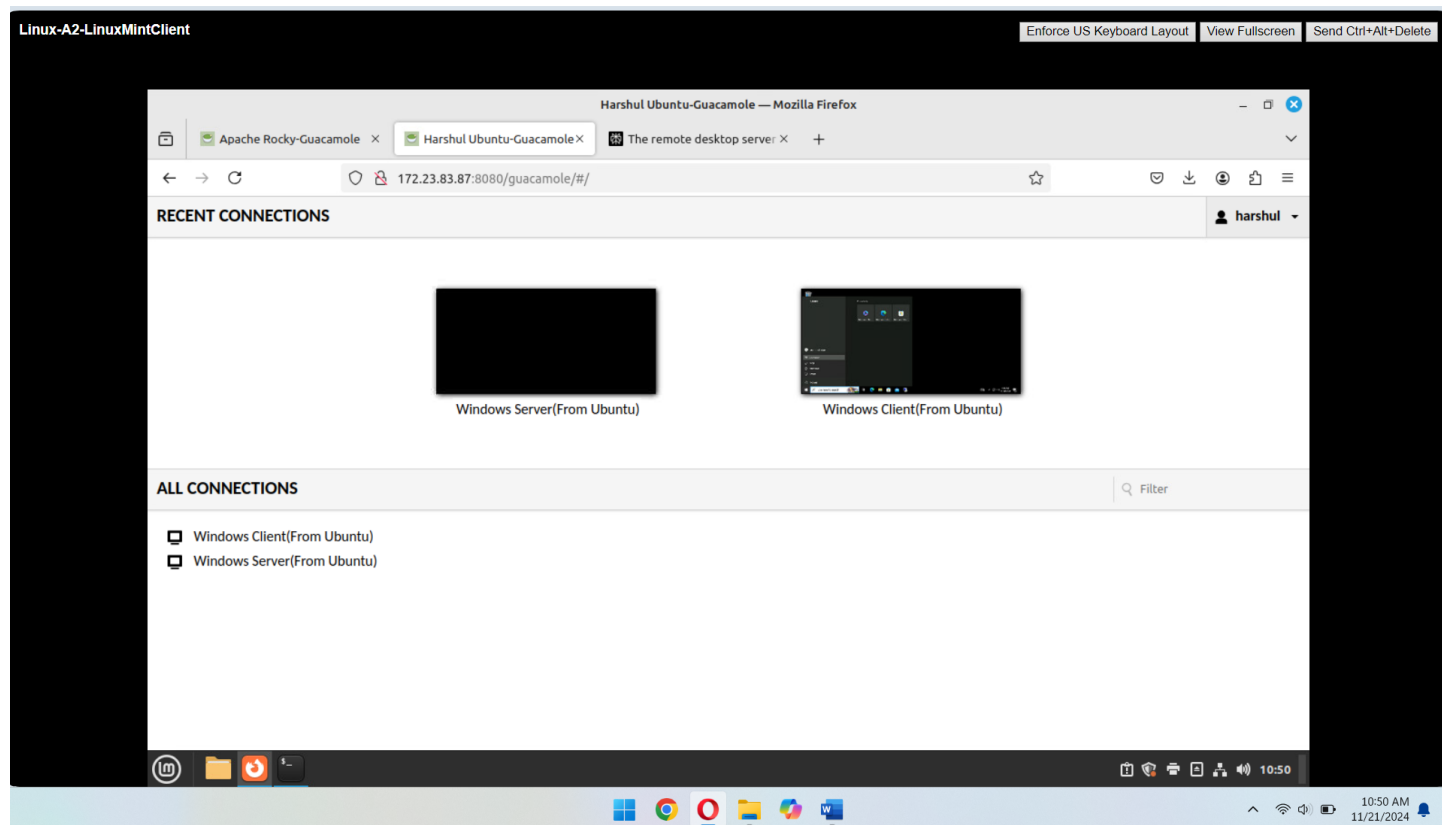
Change Ownership Back to tomcat:tomcat: `sudo chown tomcat:tomcat guacamole`

For the Translations directory: `sudo chown tomcat:tomcat translations`

Login to the Guacamole to check the connection , using IP of ubuntu server as shown below.



Once we log in we will be able to Do RDP for both Desktop as well as Server using Guacamole from Ubuntu as shown.



7. Configuring Guacamole in Rocky Linux

We will be using similar set up but instead of XML file we will be doing LDAP configurations from this machine

Install Necessary Packages:

```
sudo dnf install -y gcc glibc-devel mariadb mariadb-devel mariadb-server openssl-devel freerdp freerdp-devel
pango-devel libssh2-devel libtelnet-devel libvncserver-devel libjpeg-turbo-devel libpng-devel uuid-devel
tomcat tomcat-admin-webapp tomcat-webapps.
```

Enable Code Ready Builder Repository: `sudo dnf config-manager --set-enabled crb`

We can download the file from client browser and SCP it to the server just like we did for ubuntu
`scp guacamole-server-1.5.5.tar.gz 172.23.83.111:~`

Extract the TAR File: `tar -xvzf guacamole-server-1.5.5.tar.gz.`

Go in to the extracted directory: `cd guacamole-server-1.5.5/`

configure and compilation: `./configure --with-init-dir=/etc/init.d`

check that dependencies are met. You should see protocol support like:

Protocol support:

```
Kubernetes ... yes
RDP ..... Yes
SSH ..... Yes
Telnet ..... Yes
VNC ..... Yes
```

Compile and Install Guacamole Server

Compile the Source Code

```
sudo make
```

Install Guacamole Server

```
sudo make install
```

Updating system cache

```
sudo ldconfig
```

Create and Configure guacd.service

Manually Creating guacd.service file

```
sudo nano /etc/systemd/system/guacd.service
```



Start guacd Service: `sudo systemctl start guacd.service`

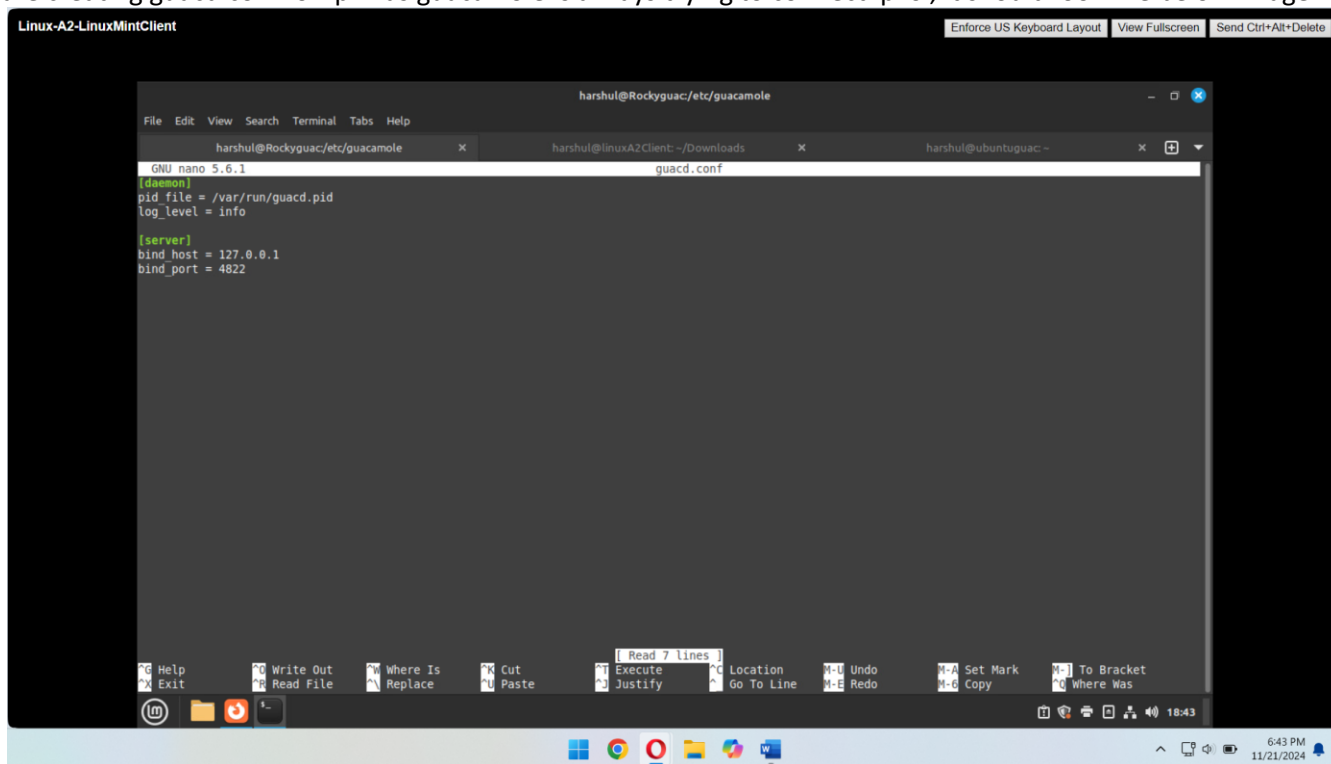
Verifying: `sudo systemctl status guacd.service`



LDAP method for login

we will modify or create **guacamole.properties** and **guacd.conf** files into guacamole home directory.

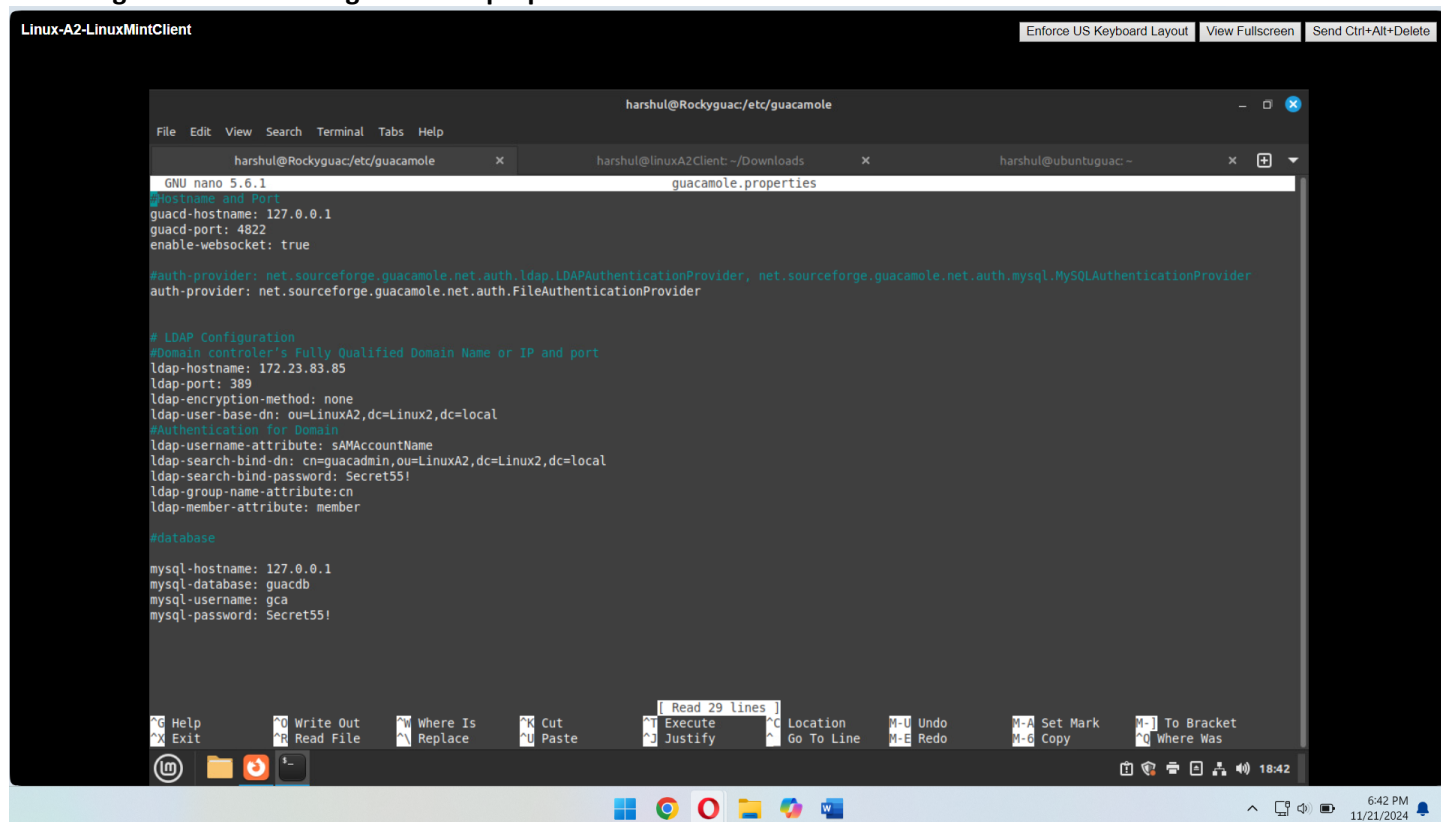
We are creating **guacd.conf** for Ipv4 as guacamole is always trying to connect ipv6 , it should look like below image.



```

harshul@Rockyguac/etc/guacamole
File Edit View Search Terminal Tabs Help
harshul@Rockyguac/etc/guacamole x harshul@linuxA2Client: ~/Downloads x harshul@ubuntu:guac ~ x
GNU nano 5.6.1 guacd.conf
[daemon]
pid_file = /var/run/guacd.pid
log_level = info
[server]
bind_host = 127.0.0.1
bind_port = 4822
  
```

Following are the details of **guacamole.properties** file.



```

harshul@Rockyguac/etc/guacamole
File Edit View Search Terminal Tabs Help
harshul@Rockyguac/etc/guacamole x harshul@linuxA2Client: ~/Downloads x harshul@ubuntu:guac ~ x
GNU nano 5.6.1 guacamole.properties
#hostname and port
guacd-hostname: 127.0.0.1
guacd-port: 4822
enable-websocket: true

#auth-provider: net.sourceforge.guacamole.net.auth.ldap.LDAPAuthenticationProvider, net.sourceforge.guacamole.net.auth.mysql.MySQLAuthenticationProvider
auth-provider: net.sourceforge.guacamole.net.auth.FileAuthenticationProvider

# LDAP Configuration
#Domain controller's Fully Qualified Domain Name or IP and port
ldap-hostname: 172.23.83.85
ldap-port: 389
ldap-encryption-method: none
ldap-user-base-dn: ou=LinuxA2,dc=Linux2,dc=local
#Authentication for Domain
ldap-username-attribute: sAMAccountName
ldap-search-bind-dn: cn=guacadmin,ou=LinuxA2,dc=Linux2,dc=local
ldap-search-bind-password: Secret55!
ldap-group-name-attribute: cn
ldap-member-attribute: member

#database
mysql-hostname: 127.0.0.1
mysql-database: guacdb
mysql-username: gca
mysql-password: Secret55!
  
```

Download and Install LDAP Authentication Extension

Download LDAP Extension: `wget https://guacamole.apache.org/releases/1.5.5/guacamole-auth-ldap-1.5.5.tar.gz`

Extract the file: `tar -xvf guacamole-auth-ldap-1.5.5.tar.gz`

Move the JAR File to Extensions Folder:

`sudo cp /etc/guacamole/extensions/guacamole-auth-ldap-1.5.5/guacamole-auth-ldap-1.5.5.jar /etc/guacamole/extensions/`

Apache Tomcat in Rocky Linux

Install Apache Tomcat and OpenJDK:

`sudo dnf install java-17-openjdk-devel tomcat tomcat-admin-webapps tomcat-webapps`

Download and Deploy Guacamole WAR File

Rename and move it to tomcat : `sudo mv guacamole-1.5.5.war /var/lib/tomcat/webapps/guacamole.war`

Restart the service: `sudo systemctl restart tomcat.service`

Check the status: `sudo systemctl status tomcat.service`

The screenshot shows a terminal window titled "Linux-A2-LinuxMintClient" with the user "harshul@Rockyguac~". The terminal displays the following commands and output:

```

harshul@Rockyguac~$ cd schema/
harshul@Rockyguac schema$ ls
guacConfigGroup.ldif  guacConfigGroup.schema
harshul@Rockyguac schema$ cd /etc/guacamole/
harshul@Rockyguac guacamole$ ls
extensions  guacamole.properties  guacd.conf  lib
harshul@Rockyguac guacamole$ cd extensions/
harshul@Rockyguac extensions$ ls
guacamole-auth-jdbc-mysql-1.5.5.jar  guacamole-auth-ldap-1.5.5.jar
harshul@Rockyguac extensions$ cd
harshul@Rockyguac ~$ systemctl start status
harshul@Rockyguac ~$ systemctl start status
harshul@Rockyguac ~$ systemctl status tomcat.service
tomcat.service - Apache Tomcat Web Application Container
Loaded: loaded (/usr/lib/systemd/system/tomcat.service; enabled; preset: disabled)
Active: active (running) since Thu 2024-11-21 09:28:55 EST; 10h ago
Main PID: 145334 (java)
Tasks: 41 (limit: 23144)
Memory: 298.9M
CPU: 1min 7.926s
CGroup: /system.slice/tomcat.service
└─145334 /usr/lib/jvm/jre/bin/java -Djavax.sql.DataSource.Factory=org.apache.commons.dbcp.BasicDataSourceFactory -classpath /usr/share/tomcat/bi
Nov 21 09:31:55 Rockyguac.Linux2.local server[145334]: at org.apache.tomcat.websocket.WsRemoteEndpointImplBase.sendString(WsRemoteEndpointImplBase.java:36)
Nov 21 09:31:55 Rockyguac.Linux2.local server[145334]: at org.apache.tomcat.websocket.WsRemoteEndpointBasic.sendText(WsRemoteEndpointBasic.java:36)
Nov 21 09:31:55 Rockyguac.Linux2.local server[145334]: at org.apache.guacamole.websocket.GuacamoleWebSocketTunnelEndpoint.sendInstruction(GuacamoleWebSocketTunnelEndpoint.java:102)
Nov 21 09:31:55 Rockyguac.Linux2.local server[145334]: at org.apache.guacamole.websocket.GuacamoleWebSocketTunnelEndpoint.access$200(GuacamoleWebSocketTunnelEndpoint.java:102)
Nov 21 09:31:55 Rockyguac.Linux2.local server[145334]: at org.apache.guacamole.websocket.GuacamoleWebSocketTunnelEndpoint$2.run(GuacamoleWebSocketTunnelEndpoint$2.java:102)
Nov 21 09:32:21 Rockyguac.Linux2.local server[145334]: 09:32:21.075 [http-nio-8080-exec-6] INFO o.a.g.tunnel.TunnelRequestService - User "guacadmin" connected
Nov 21 09:33:48 Rockyguac.Linux2.local server[145334]: 09:33:48.863 [http-nio-8080-exec-3] INFO o.a.g.tunnel.TunnelRequestService - User "guacadmin" disconnected
Nov 21 09:34:04 Rockyguac.Linux2.local server[145334]: 09:34:04.163 [http-nio-8080-exec-9] INFO o.a.g.tunnel.TunnelRequestService - User "guacadmin" disconnected
Nov 21 10:46:41 Rockyguac.Linux2.local server[145334]: 10:46:41.528 [http-nio-8080-exec-1] INFO o.a.g.a.l.AuthenticationProviderService - User "guacadmin" was successfully authenticated
Nov 21 10:46:41 Rockyguac.Linux2.local server[145334]: 10:46:41.529 [http-nio-8080-exec-1] INFO o.a.g.r.auth.AuthenticationService - User "guacadmin" successfully authenticated

```

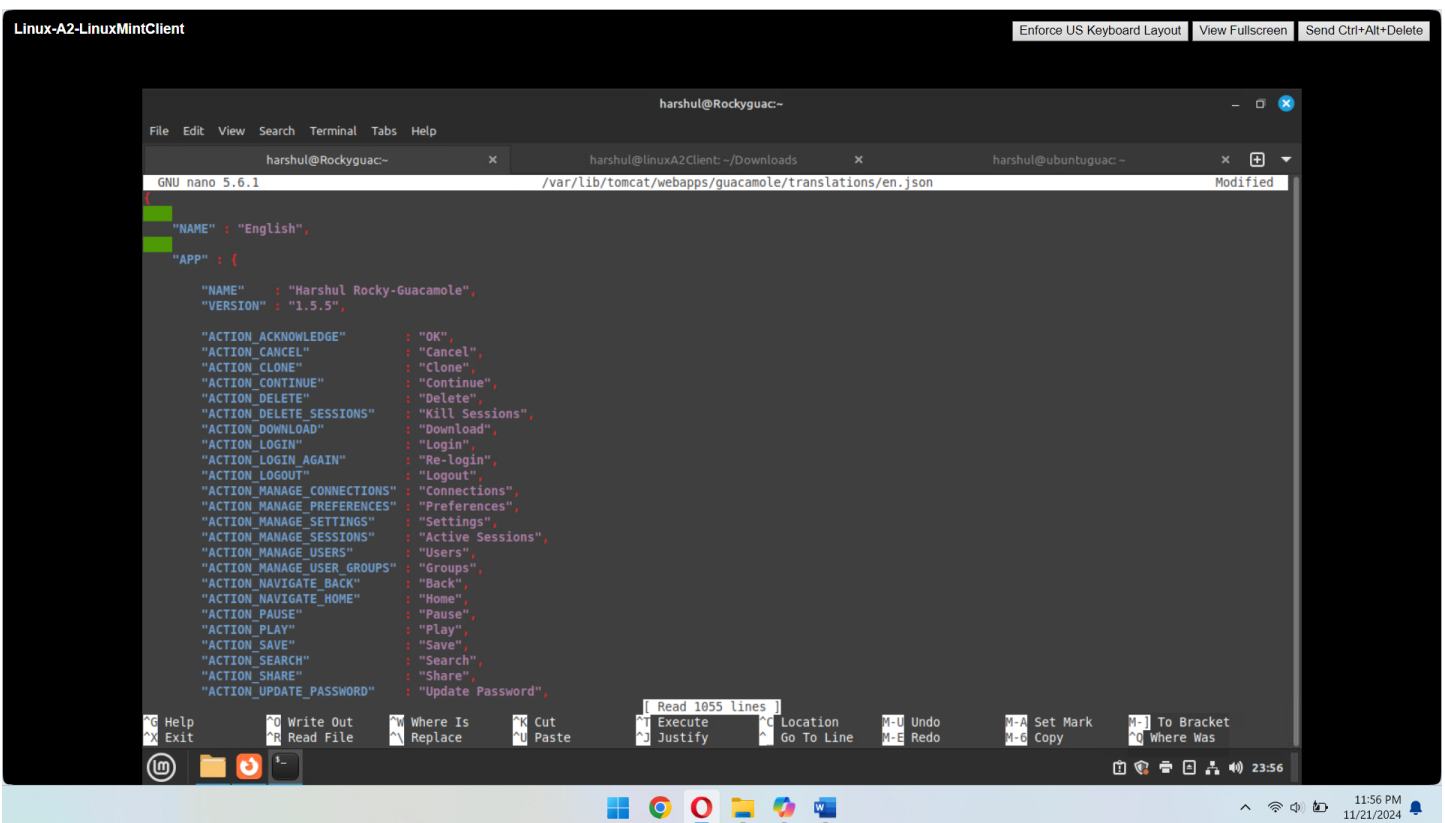
Changing the Web Page Appearance for Guacamole on Rocky Linux

Navigate to the Webapps Directory:`cd /var/lib/tomcat9/webapps/`

Open the en.jsonFile: `sudo nano /var/lib/tomcat9/webapps/guacamole/translations/en.json`

Change the title name to:"NAME": "Harshul Rocky-Guacamole"

Save and Exit: Ctrl + O , Ctrl + X



Database Setup for Guacamole on Rocky Linux

Install MariaDB Server

Database Install :`sudo dnf install mariadb-server`

Database enable: `sudo systemctl enable mariadb.service`

Database start: `sudo systemctl start mariadb.service`

Database status: `sudo systemctl status mariadb.service`

If you have already installed it with dependencies, then check the status of database

```

Linux-A2-LinuxMintClient
Enforce US Keyboard Layout View Fullscreen Send Ctrl+Alt+Delete

harshul@Rockyguac~
File Edit View Search Terminal Tabs Help

harshul@Rockyguac~ x harshul@linuxA2Client: ~/Downloads x harshul@ubuntuquac: ~ x
└─145334 /usr/lib/jvm/jre/bin/java -Djavax.sql.DataSource.Factory=org.apache.commons.dbcp.BasicDataSourceFactory -classpath /usr/share/tomcat/b...
Nov 21 09:31:55 Rockyguac.Linux2.local server[145334]: at org.apache.tomcat.websocket.WsRemoteEndpointImplBase.sendString(WsRemoteEndpointImplBase.java:36)
Nov 21 09:31:55 Rockyguac.Linux2.local server[145334]: at org.apache.tomcat.websocket.WsRemoteEndpointBasic.sendText(WsRemoteEndpointBasic.java:36)
Nov 21 09:31:55 Rockyguac.Linux2.local server[145334]: at org.apache.guacamole.websocket.GuacamoleWebSocketTunnelEndpoint.sendInstruction(GuacamoleWebSocketTunnelEndpoint.java:200)
Nov 21 09:31:55 Rockyguac.Linux2.local server[145334]: at org.apache.guacamole.websocket.GuacamoleWebSocketTunnelEndpoint.access$200(GuacamoleWebSocketTunnelEndpoint.java:200)
Nov 21 09:31:55 Rockyguac.Linux2.local server[145334]: at org.apache.guacamole.websocket.GuacamoleWebSocketTunnelEndpoint$2.run(GuacamoleWebSocketTunnelEndpoint$2.java:200)
Nov 21 09:32:21 Rockyguac.Linux2.local server[145334]: 09:32:21.075 [http-nio-8080-exec-6] INFO o.a.g.tunnel.TunnelRequestService - User "guacadmin" connected
Nov 21 09:33:48 Rockyguac.Linux2.local server[145334]: 09:33:48.863 [http-nio-8080-exec-3] INFO o.a.g.tunnel.TunnelRequestService - User "guacadmin" disconnected
Nov 21 09:34:04 Rockyguac.Linux2.local server[145334]: 09:34:04.163 [http-nio-8080-exec-9] INFO o.a.g.tunnel.TunnelRequestService - User "guacadmin" disconnected
Nov 21 10:46:41 Rockyguac.Linux2.local server[145334]: 10:46:41.528 [http-nio-8080-exec-1] INFO o.a.g.a.l.AuthenticationProviderService - User "guacadmin" was authenticated
Nov 21 10:46:41 Rockyguac.Linux2.local server[145334]: 10:46:41.529 [http-nio-8080-exec-1] INFO o.a.g.r.auth.AuthenticationService - User "guacadmin" successfully authenticated

^X
^C
[harshul@Rockyguac ~]$
[harshul@Rockyguac ~]$
[harshul@Rockyguac ~]$ sudo nano /var/lib/tomcat/webapps/guacamole/translations/en.json
[sudo] password for harshul:
[harshul@Rockyguac ~]$ systemctl status mariadb.service
● mariadb.service - MariaDB 10.5 database server
   Loaded: loaded (/usr/lib/systemd/system/mariadb.service; enabled; preset: disabled)
   Active: active (running) since Thu 2024-11-21 08:30:18 EST; 11h ago
     Docs: man:mariadb(8)
           https://mariadb.com/kb/en/library/systemd/
   Main PID: 141951 (mariabdd)
   Status: "Taking your SQL requests now..."
     Tasks: 8 (limit: 23144)
    Memory: 83.9M
       CPU: 7.619s
   CGroup: /system.slice/mariadb.service
           └─141951 /usr/libexec/mariabdd --basedir=/usr

Nov 21 08:30:17 Rockyguac.Linux2.local systemd[1]: Starting MariaDB 10.5 database server...
Nov 21 08:30:17 Rockyguac.Linux2.local mariadb-prepare-db-dir[141916]: Database MariaDB is probably initialized in /var/lib/mysql already, nothing is done.
Nov 21 08:30:17 Rockyguac.Linux2.local mariadb-prepare-db-dir[141916]: If this is not the case, make sure the /var/lib/mysql is empty before running mariadb-prepare-db-dir.
Nov 21 08:30:18 Rockyguac.Linux2.local systemd[1]: Started MariaDB 10.5 database server.
lines 1-17/17 (END)

```

Now, we are going to create database and add user to database and give permissions

Open database as the root user: `sudo mysql -u root -p`

Enter password and then create a database

Create database : Create database guacdb;

Create user and give password: create user gca@localhost identified by 'Secret55!';

Grant permissions: grant SELECT,UPDATE,INSERT,DELETE on guacdb.* to gca@localhost;

Apply: flush privileges;

Check the user and database:

`SELECT user FROM mysql.user;`

`show databases;`

The screenshot shows a terminal window titled 'harshul@Rockyguac~' with three tabs: 'harshul@Rockyguac~', 'harshul@linuxA2Client: ~/Downloads', and 'harshul@ubuntuguac: ~'. The terminal displays the following commands and output:

```

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

MariaDB [(none)]> select user from mysql.user;
+-----+
| User          |
+-----+
| gca           |
| guacadmin     |
| mariadb.sys   |
| mysql         |
| root          |
+-----+
5 rows in set (0.045 sec)

MariaDB [(none)]> show databases;
+-----+
| Database      |
+-----+
| guacdb        |
| information_schema |
| mysql         |
| performance_schema |
+-----+
4 rows in set (0.000 sec)

MariaDB [(none)]>

```

The terminal window has a menu bar with 'File', 'Edit', 'View', 'Search', 'Terminal', 'Tabs', and 'Help'. The bottom status bar shows system icons and the time '10:15 PM 11/21/2024'.

Adding JDBC Authentication for Guacamole on Rocky Linux

Use **wget** to download the JDBC file:

wget <https://guacamole.apache.org/releases/1.5.5/guacamole-auth-jdbc-1.5.5.tar.gz>

Extract the File: `tar -xzf guacamole-auth-jdbc-1.5.5.tar.gz`

Once it is extracted go to the file and go to **sql** folder: `cd guacamole-auth-jdbc-1.5.5/mysql`

Move the JAR file to the extensions directory: `sudo cp guacamole-auth-jdbc-1.5.5.jar /etc/guacamole/extensions`

Add Schema Files to the Database: check you are in the **sql** directory then run:

`sudo mysql -u root -p guacdb < schema/001-createschema.sql`

`sudo mysql -u root -p guacdb < schema/002-createadmin-user.sql`

Download and Install MySQL Connector

Download MySQL Connector: `wget https://dev.mysql.com/get/Downloads/Connector-J/mysql-connector-j8.0.31.tar.gz`

extract it : `tar xzvf mysql-connector-j-8.0.31.tar.gz`

Copy MySQL Connector to lib Directory:

Go to directory : `cd /path/to/extracted/mysql-connector-j-8.0.31/`

Copy the JAR File to lib Directory: `sudo cp mysql-connector-j-8.0.31.jar /etc/guacamole/lib/`

Update guacamole.properties : sudo nano /etc/guacamole/guacamole.properties

```

harshul@Rockyguac/etc/guacamole
File Edit View Search Terminal Tabs Help

harshul@Rockyguac/etc/guacamole x harshul@linuxA2Client: ~/Downloads x harshul@ubuntuquac: ~ x
guacamole.properties

GNU nano 5.6.1
#hostname and port
guacd-hostname: 127.0.0.1
guacd-port: 4822
enable-websocket: true

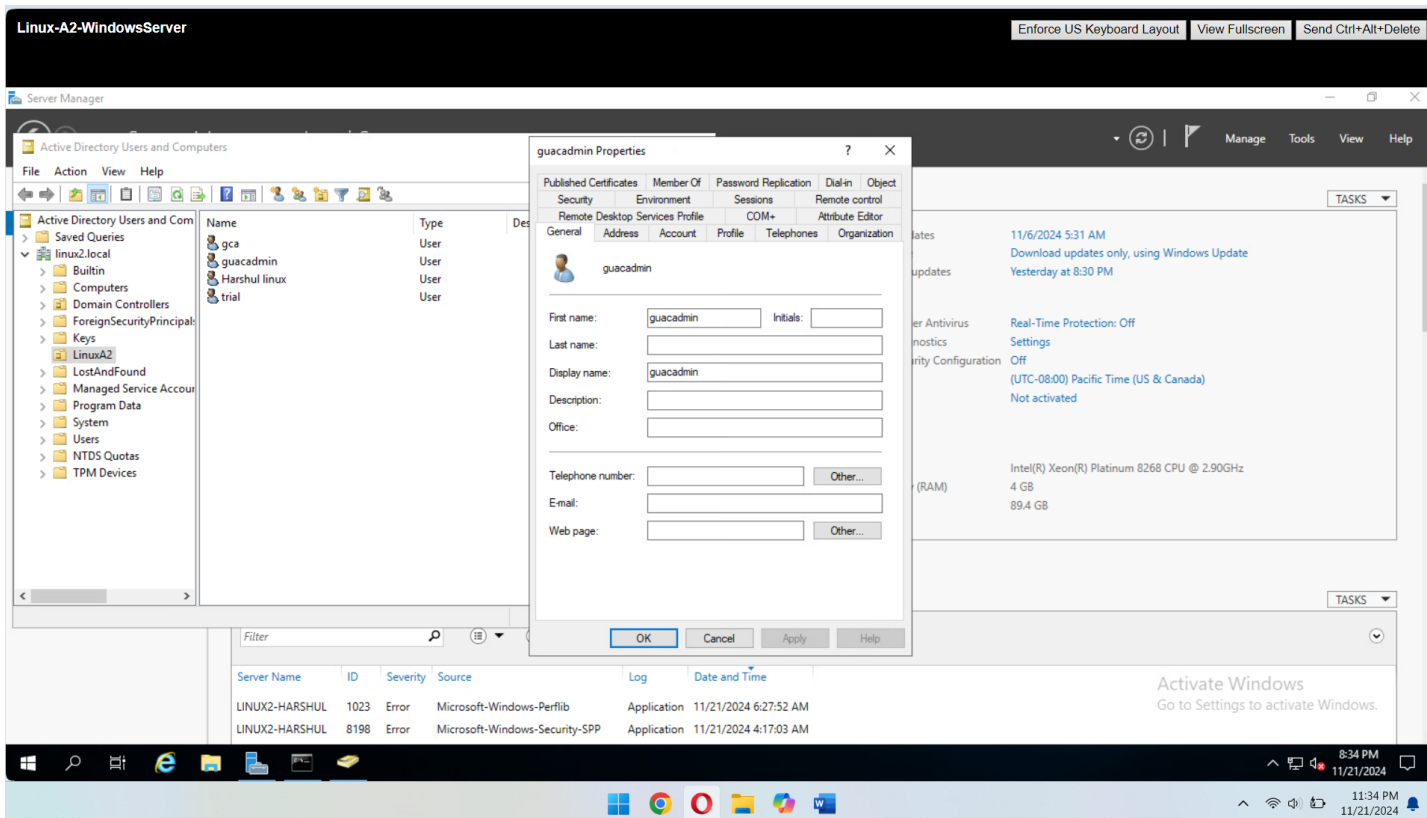
#auth-provider: net.sourceforge.guacamole.net.auth.ldap.LDAPAuthenticationProvider, net.sourceforge.guacamole.net.auth.mysql.MySQLAuthenticationProvider
auth-provider: net.sourceforge.guacamole.net.auth.FileAuthenticationProvider

# LDAP Configuration
#Domain controller's Fully Qualified Domain Name or IP and port
ldap-hostname: 172.23.83.85
ldap-port: 389
ldap-encryption-method: none
ldap-user-base-dn: ou=LinuxA2,dc=Linux2,dc=local
#Authentication for Domain
ldap-username-attribute: sAMAccountName
ldap-search-bind-dn: cn=guacadmin,ou=LinuxA2,dc=Linux2,dc=local
ldap-search-bind-password: Secret55!
ldap-group-name-attribute: cn
ldap-member-attribute: member

#database
mysql-hostname: 127.0.0.1
mysql-database: guacdb
mysql-username: gca
mysql-password: Secret55!

Help Write Out Where Is Cut Read 29 lines Location M-U Undo M-A Set Mark M-] To Bracket
Exit Read File Replace Paste Justify Go To Line M-B Redo M-G Copy M-; Where Was
  
```

We need to create guacadmin in AD in Domain controller as default username is guacadmin in database so we can log in and make it work.



Restart all the services and check the status of all services

Sudo systemctl restart tomcat.service mariadb.service guacd.service

Sudo systemctl status tomcat.service mariadb.service guacd.service

```

harshul@Rockyguac:~
File Edit View Search Terminal Tabs Help

harshul@Rockyguac:~
harshul@linuxA2Client: ~/Downloads
harshul@ubuntuiguac: ~

Loaded: loaded (/etc/systemd/system/guacd.service; enabled; preset: disabled)
Active: active (running) since Thu 2024-11-21 09:28:54 EST; 14h ago
Main PID: 145329 (guacd)
Tasks: 1 (limit: 23144)
Memory: 10.7M
CPU: 3.672s
CGroup: /system.slice/guacd.service
└─145329 /usr/local/sbin/guacd -f

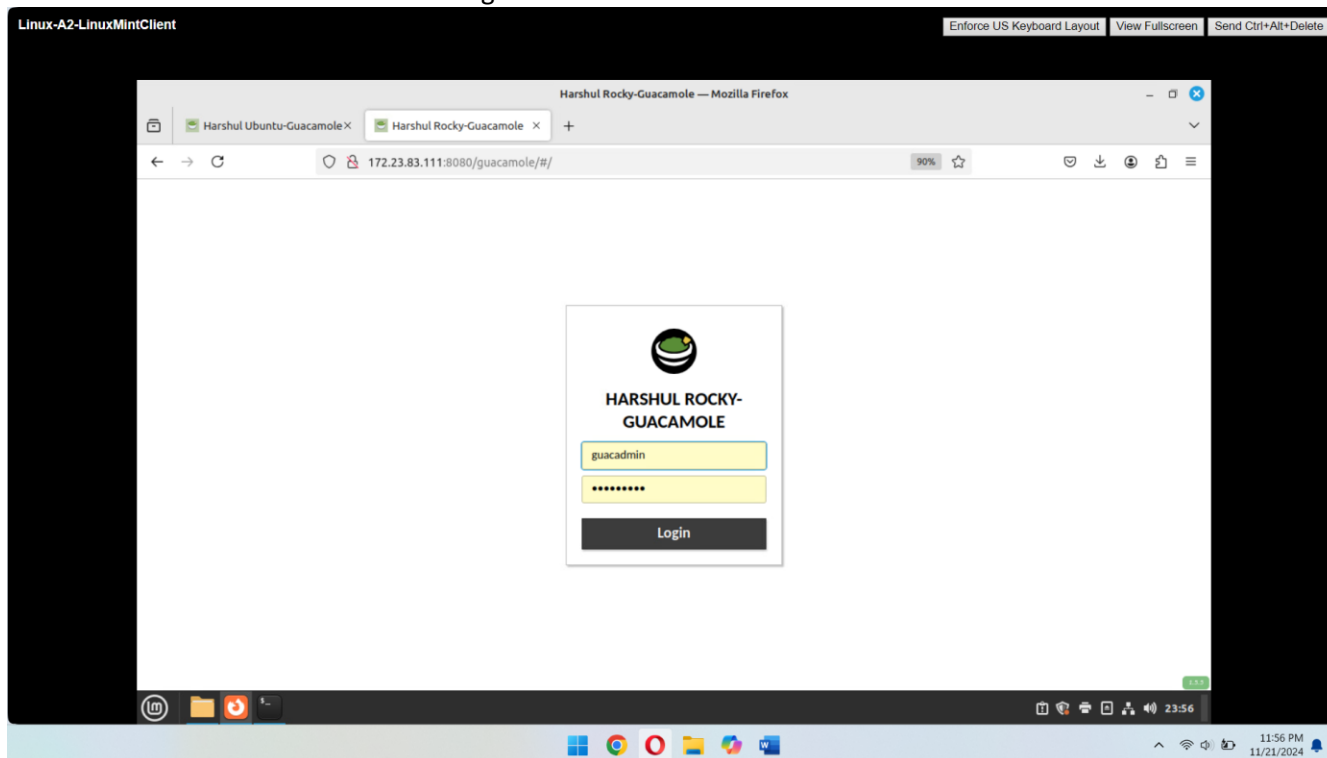
Nov 21 09:33:48 Rockyguac.Linux2.local guacd[145329]: Connection "$db81ef68-1e1d-4390-ae71-1202b5670fa3" removed.
Nov 21 09:33:48 Rockyguac.Linux2.local guacd[145329]: guacd[145329]: INFO: Connection "$db81ef68-1e1d-4390-ae71-1202b5670fa3" removed.
Nov 21 09:34:04 Rockyguac.Linux2.local guacd[145905]: User "@cc2d6694-9f2c-435e-a19c-3875b0211b9a" disconnected (0 users remain)
Nov 21 09:34:04 Rockyguac.Linux2.local guacd[145905]: guacd[145905]: INFO: User "@cc2d6694-9f2c-435e-a19c-3875b0211b9a" disconnected (0 users remain)
Nov 21 09:34:04 Rockyguac.Linux2.local guacd[145905]: guacd[145905]: INFO: Last user of connection "$36249250-48e3-47d4-a970-a14d17ee453c" disconnected
Nov 21 09:34:04 Rockyguac.Linux2.local guacd[145905]: Last user of connection "$36249250-48e3-47d4-a970-a14d17ee453c" disconnected
Nov 21 09:34:04 Rockyguac.Linux2.local guacd[145905]: Internal RDP client disconnected
Nov 21 09:34:04 Rockyguac.Linux2.local guacd[145905]: guacd[145905]: INFO: Internal RDP client disconnected
Nov 21 09:34:04 Rockyguac.Linux2.local guacd[145329]: Connection "$36249250-48e3-47d4-a970-a14d17ee453c" removed.
Nov 21 09:34:04 Rockyguac.Linux2.local guacd[145329]: guacd[145329]: INFO: Connection "$36249250-48e3-47d4-a970-a14d17ee453c" removed.

● tomcat.service - Apache Tomcat Web Application Container
Loaded: loaded (/usr/lib/systemd/system/tomcat.service; enabled; preset: disabled)
Active: active (running) since Thu 2024-11-21 09:28:55 EST; 14h ago
Main PID: 145334 (java)
Tasks: 41 (limit: 23144)
Memory: 299.0M
CPU: 1min 22.759s
CGroup: /system.slice/tomcat.service
└─145334 /usr/lib/jvm/jre/bin/java -Djavax.sql.DataSource.Factory=org.apache.commons.dbcp.BasicDataSourceFactory

Nov 21 09:31:55 Rockyguac.Linux2.local server[145334]: at org.apache.tomcat.websocket.WsRemoteEndpointImplBase.sendSt
lines 1-32... skipping...
● guacd.service - Guacamole proxy daemon
Loaded: loaded (/etc/systemd/system/guacd.service; enabled; preset: disabled)
Active: active (running) since Thu 2024-11-21 09:28:54 EST; 14h ago
Main PID: 145329 (guacd)
Tasks: 1 (limit: 23144)

```

Go to the browser and check with login



We can see our users

Linux-A2-LinuxMintClient

Enforce US Keyboard Layout View Fullscreen Send Ctrl+Alt+Delete

Harshul Rocky-Guacamole — Mozilla Firefox

Harshul Ubuntu-Guacamole x Harshul Rocky-Guacamole x +

172.23.83.111:8080/guacamole/#/settings/users 90%

SETTINGS guacadmin

Active Sessions History Users Groups Connections Preferences

Click or tap on a user below to manage that user. Depending on your access level, users can be added and deleted, and their passwords can be changed.

New User Filter

Username	Organization	Full name	Last active
gca			
guacadmin			2024-11-21 23:58:06
harshul			
trial			

12:02 AM 11/22/2024

Once logged in go to setting and add connections for RDP and check that it works

Linux-A2-LinuxMintClient

Enforce US Keyboard Layout View Fullscreen Send Ctrl+Alt+Delete

Harshul Rocky-Guacamole — Mozilla Firefox

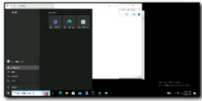
Harshul Ubuntu-Guacamole x Harshul Rocky-Guacamole x +

172.23.83.111:8080/guacamole/#/ 90%

RECENT CONNECTIONS guacadmin



Windows-Server-Harshul



Windows-Desktop-Harshul



RDP TEST SERVER

ALL CONNECTIONS Filter

- ☐ RDP TEST SERVER
- ☐ Windows-Desktop-Harshul
- ☐ Windows-Server-Harshul

172.23.83.111:8080/guacamole/#/client/MwBJAG15C3Fs

23:59 11:59 PM 11/21/2024

8. Loadbalancer and Reverse Proxy

install the apache2 server and other dependencies for load balancing

Install Apache2:sudo apt install apache2

Install Additional Apache2 Modules:

```
sudo apt install apache2-dev apache2-utils apache2-data
```

Enable required modules.

Enable Proxy Module:sudo a2enmod proxy

Enable Proxy HTTP Module: `sudo a2enmod proxy_http`

Enable Load Balancer Module:sudo a2enmod mod_balancer

Enable Load Balancing Method by Requests Module:sudo a2enmod lbmethod_byrequests

Make sure the firewall is disabled

Disable UFW Service: `sudo systemctl disable ufw.service`

Stop UFW Service:sudo systemctl stop ufw.service

Now enable and restart the apache2

Enable Apache2 to Start at Boot:sudo systemctl enable apache2

Restart Apache2 Service: `sudo systemctl restart apache2.service`

Check Apache2 Service Status: `sudo systemctl status apache2.service`

[illegible]

Configure the .conf file for load balancing

Go to file: `cd /etc/apache2/sites-enabled/`

Edit it: `sudo nano 00-default.conf`

Follow the image below for details

The screenshot shows a terminal window titled "harshul@ubuntu: /etc/apache2/sites-enabled" with the file "00-default.conf" open in nano 6.2. The configuration includes a VirtualHost for *:80 with ServerName www.linuxtest.ca. It defines a Proxy balancer for lb_guacamole with two BalancerMember entries: http://172.23.83.111:8080/guacamole and http://ubuntuguac.linux2.local:8080/guacamole. The ProxySet lbmethod=byrequests and ProxySet stickySession=ROUTEID are configured. A Location /websocket-tunnel is also defined with ProxyPass and ProxyPassReverse. The Header add Set-Cookie "ROUTEID=.%{BALANCER_WORKER_ROUTE}e; path=/" env=BALANCER_ROUTE_CHANGED is added. The ErrorLog and CustomLog are also configured.

```

harshul@ubuntu: /etc/apache2/sites-enabled
GNU nano 6.2
00-default.conf
<VirtualHost *:80>
  ServerName www.linuxtest.ca

  ProxyPreserveHost On
  ProxyRequests Off

  <Proxy balancer://lb_guacamole>
    BalancerMember http://172.23.83.111:8080/guacamole route=172.23.83.111
    BalancerMember http://ubuntuguac.linux2.local:8080/guacamole
    route=172.23.83.87
    BalancerMember http://172.23.83.111:8080/guacamole route=172.23.83.111
    ProxySet lbmethod=byrequests
    ProxySet stickySession=ROUTEID
  </Proxy>

  ProxyPass / balancer://lb_guacamole/
  ProxyPassReverse / balancer://lb_guacamole/

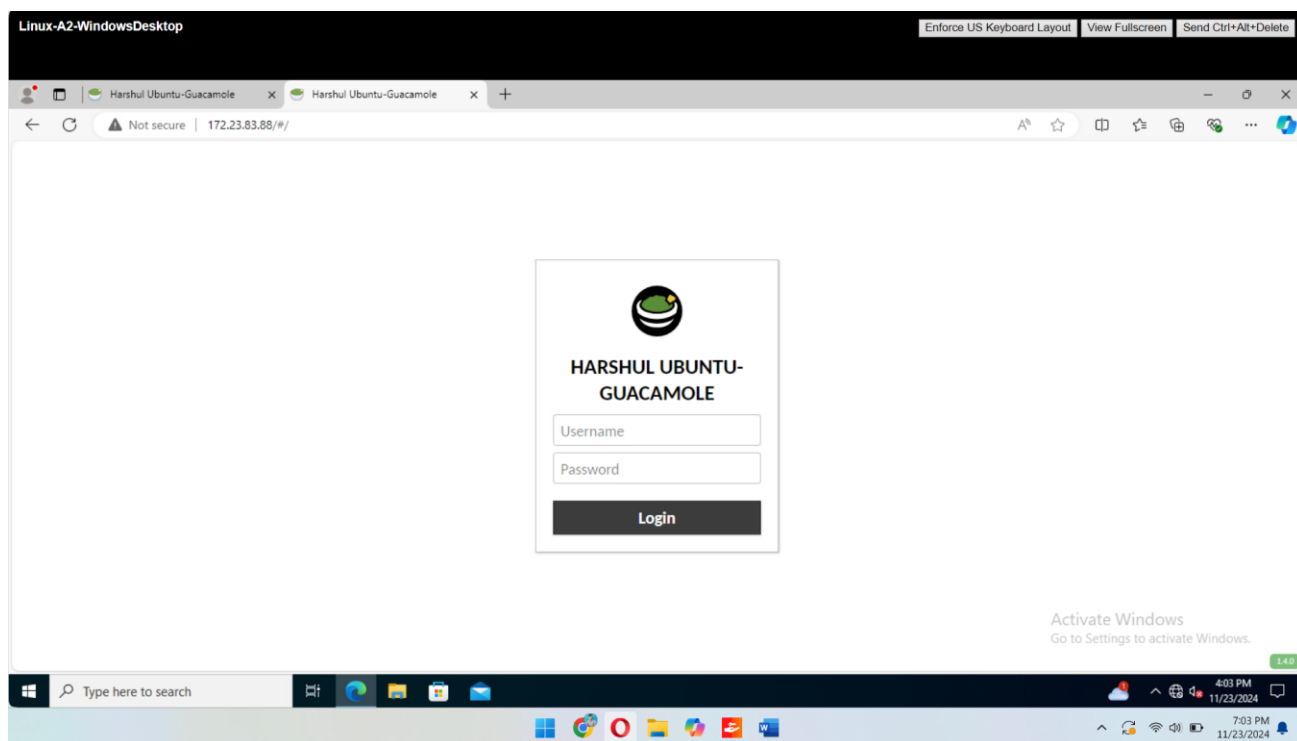
  <Location /websocket-tunnel>
    ProxyPass ws://balancer://lb_guacamole/websocket-tunnel
    ProxyPassReverse ws://balancer://lb_guacamole/websocket-tunnel
  </Location>

  Header add Set-Cookie "ROUTEID=.%{BALANCER_WORKER_ROUTE}e; path=/" env=BALANCER_ROUTE_CHANGED

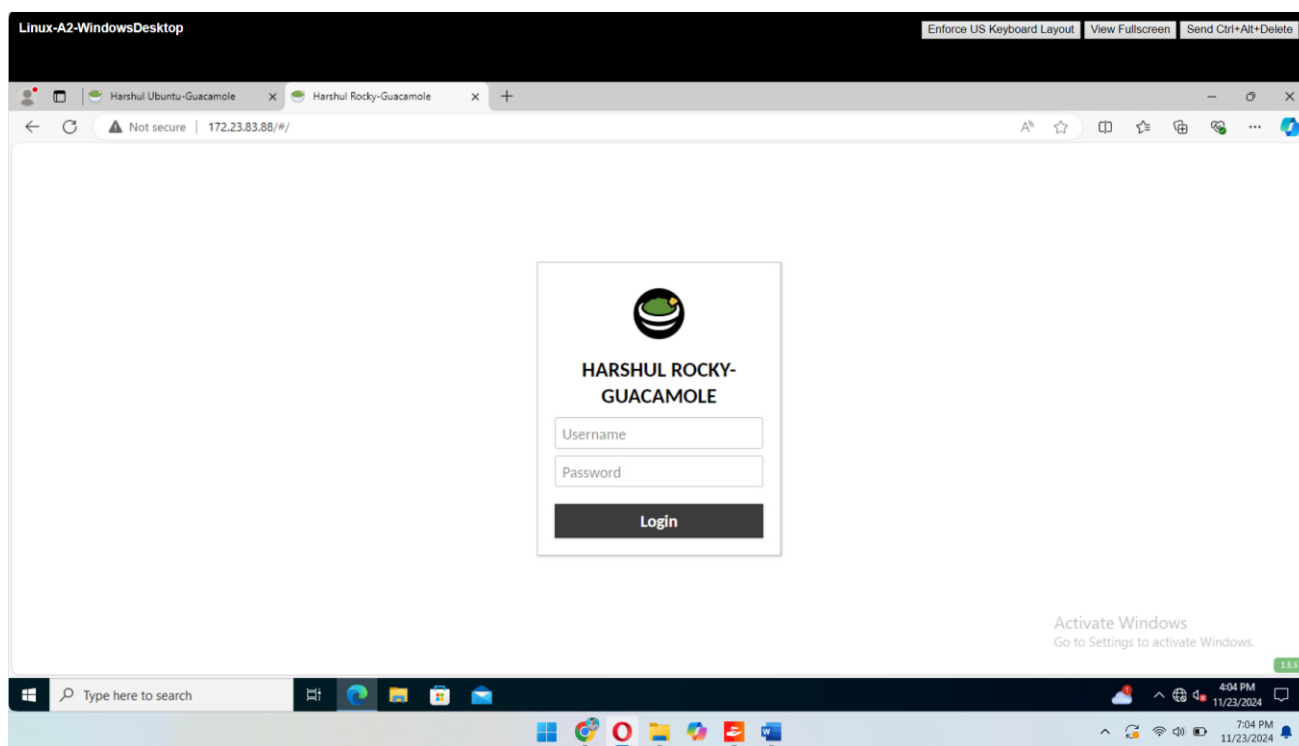
  ErrorLog ${APACHE_LOG_DIR}/error.log
  CustomLog ${APACHE_LOG_DIR}/access.log combined
</VirtualHost>

```

go to browser and type the ip address of the apache2 server : **172.23.83.88**

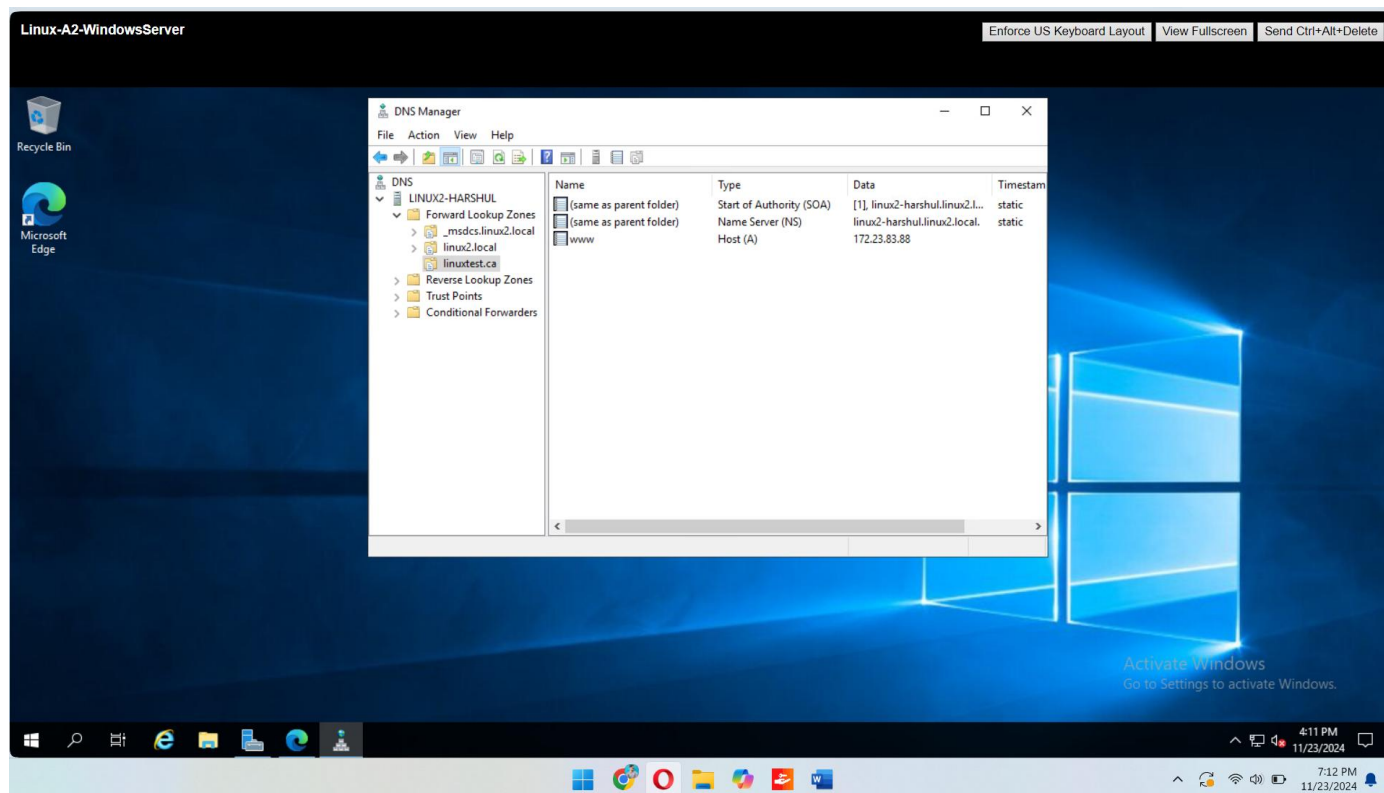


Power down ubuntu guacamole and you should be able to see the Rocky guacamole login page as well



Reverse Proxy Configuration

Go to Domain Controller and check DNS Manager see record is present and make forward lookup zone name linuxtest.ca.



Create Forward Lookup Zone

Right-click on **Forward Lookup Zone**.

Select **New Zone**.

Create **Primary Zone**

Create Host Record for Network Load Balancer

Inside new zone > right-click and select **New Host (A or AAAA)**.

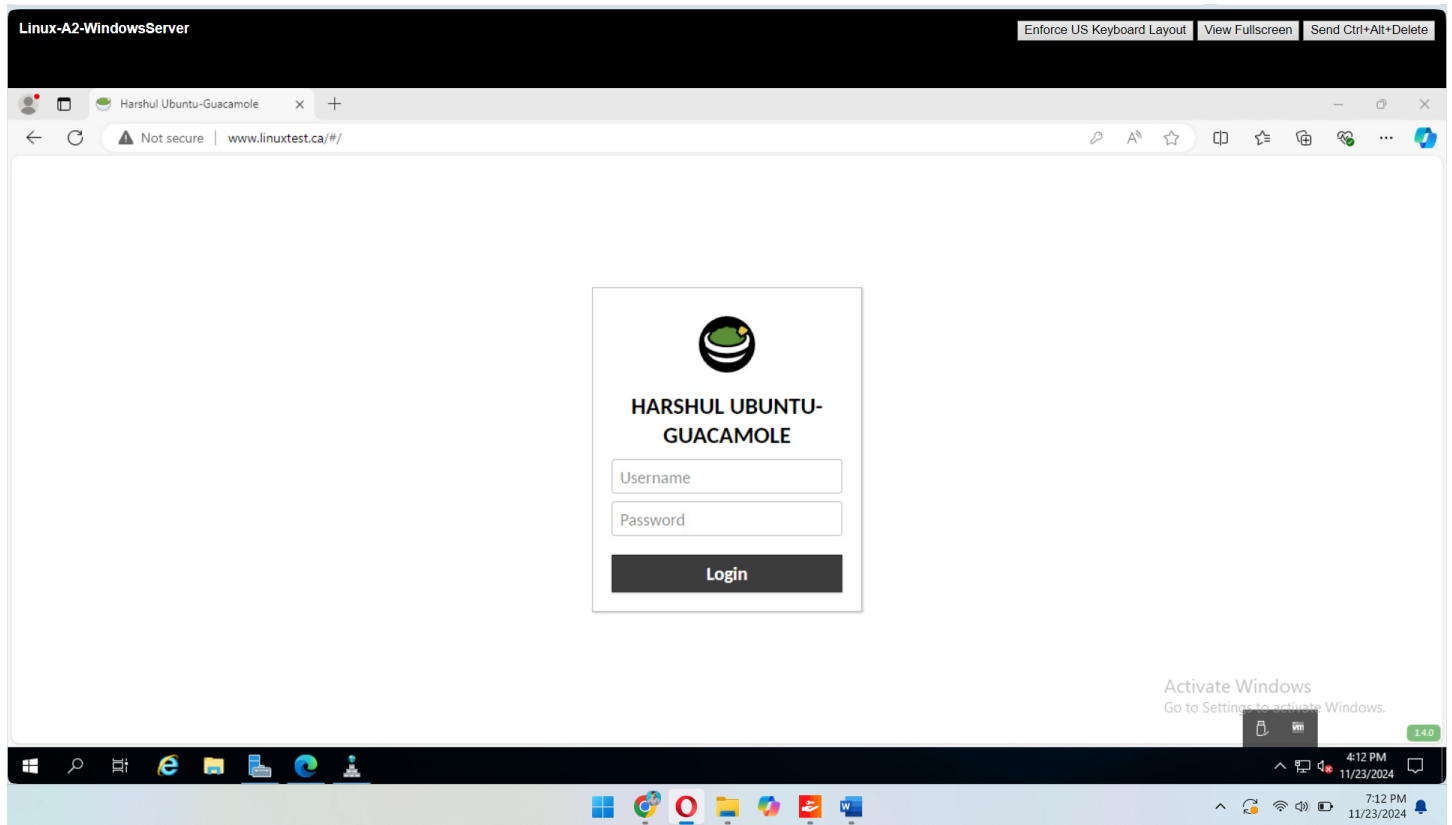
Enter **www** as name and **172.23.83.88** as IP address.

Verify Configuration

go to <http://www.linuxtest.ca>. It will go to one of load balancing servers.

Test Load Balancer

Turn off the Fedora server and verify that load balancer still redirects properly.



References

Apache GuacamoleTM: 1.4.0. (n.d.). <https://guacamole.apache.org/releases/1.4.0/>

Apache GuacamoleTM: 1.5.5. (n.d.). <https://guacamole.apache.org/releases/1.5.5/>

Installing Guacamole natively — Apache Guacamole Manual v1.5.5. (n.d.).

<https://guacamole.apache.org/doc/gug/installing-guacamole.html>

LDAP authentication — Apache Guacamole Manual v1.5.5. (n.d.).

<https://guacamole.apache.org/doc/gug/ldap-auth.html>

Proxying Guacamole — Apache Guacamole manual V1.5.5. (n.d.).

<https://guacamole.apache.org/doc/gug/reverse-proxy.html>