CYBER SECURITY INTERNSHIP

Task 14

LINUX SERVER HARDENING & SECURE CONFIGURATION

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Environment: Ubuntu Server on VirtualBox

Server hardening is the process of securing a server by reducing its attack surface, eliminating unnecessary services, applying security patches, and implementing strict access controls. The goal is to protect the system from unauthorized access, malware, and cyber attacks.
In this project, Ubuntu Linux was installed in Oracle VirtualBox and hardened using industry-recommended security practices.

Objective

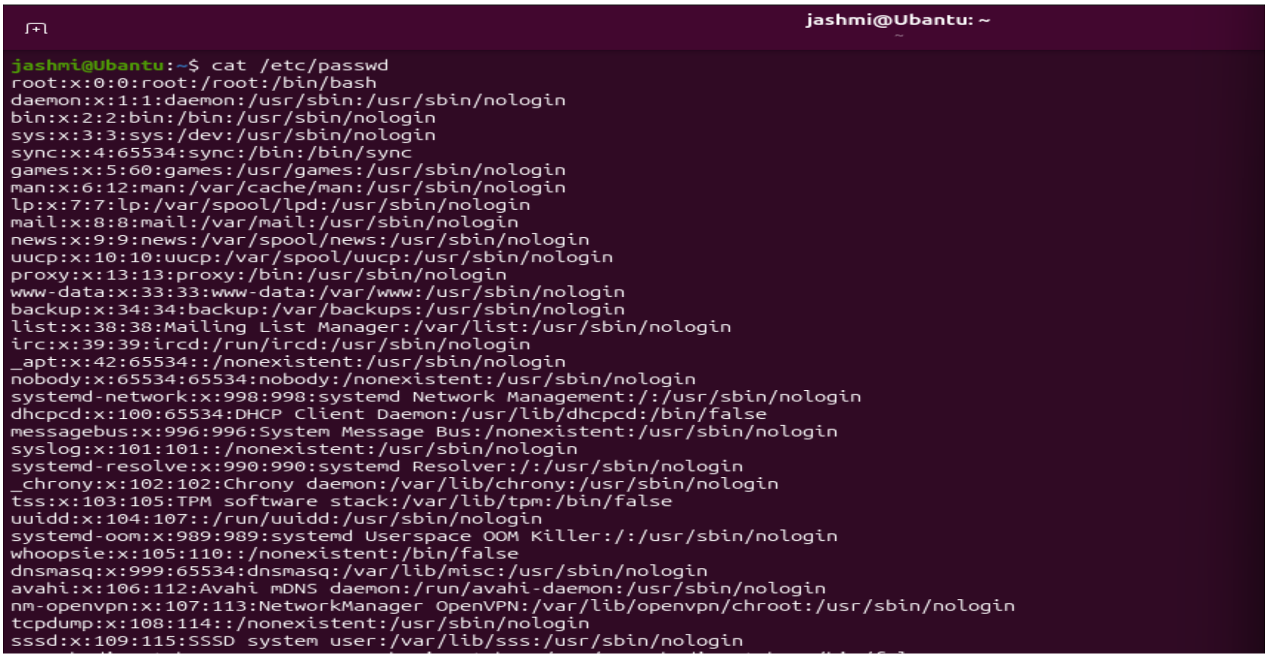
- To secure an Ubuntu server installed on VirtualBox.
- To implement authentication and access control mechanisms.
- To configure firewall and network security.
- To reduce vulnerabilities by disabling unnecessary services.
- To perform a security audit using Lynis.

Hardening Implementation Steps

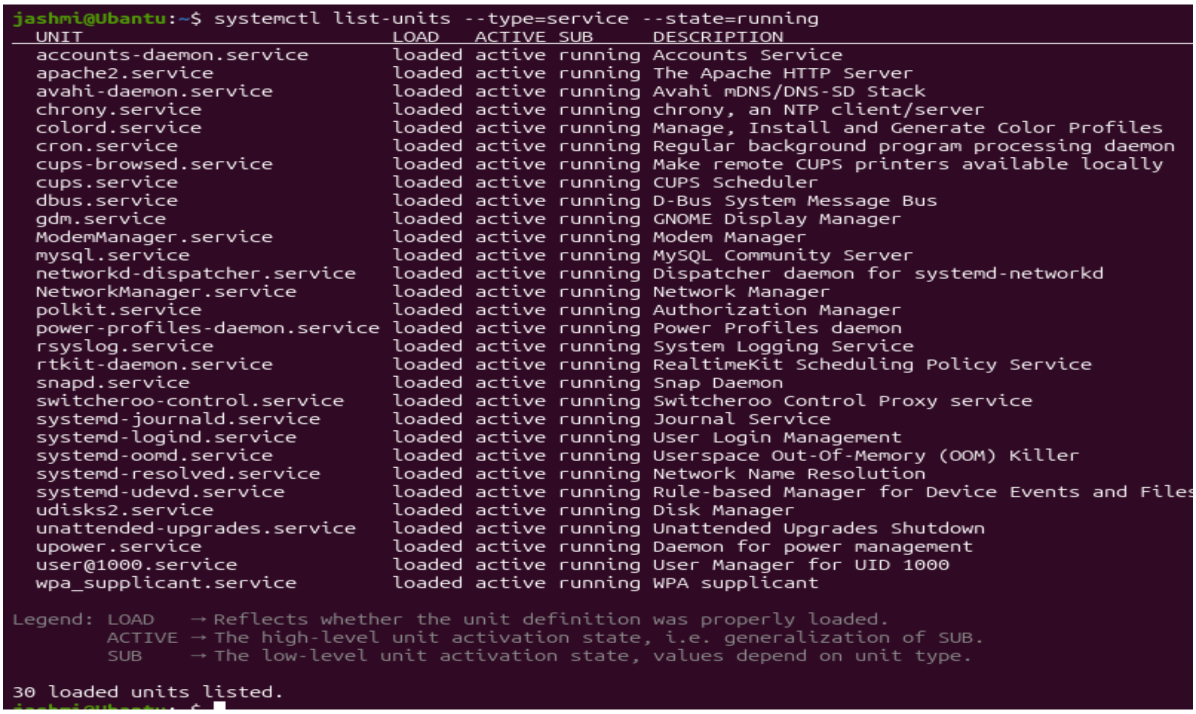
Review Default Linux System Settings

The default Linux system configuration was reviewed to understand existing user accounts, running services, and open network ports. This step helps in identifying unnecessary users and exposed services that may increase security risks.

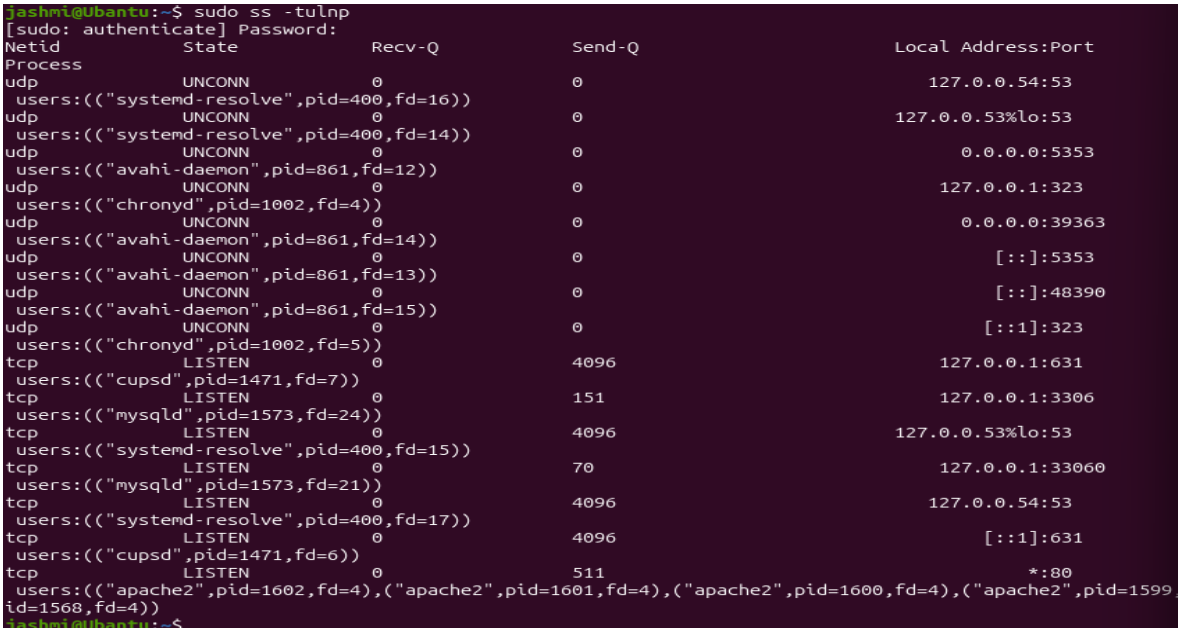
The system users were examined, active services were listed, and open ports were analyzed to assess the initial security posture of the Ubuntu server.



```
jashmi@Ubantu:~$ cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
irc:x:39:39:ircd:/run/ircd:/usr/sbin/nologin
_apt:x:42:65534::/nonexistent:/usr/sbin/nologin
nobody:x:65534:65534:nobody:/nonexistent:/usr/sbin/nologin
systemd-network:x:998:998:systemd Network Management:/:/usr/sbin/nologin
dhcpcd:x:100:65534:DHCP Client Daemon:/usr/lib/dhcpcd:/bin/false
messagebus:x:996:996:System Message Bus:/nonexistent:/usr/sbin/nologin
syslog:x:101:101::/nonexistent:/usr/sbin/nologin
systemd-resolve:x:990:990:systemd Resolver:/:/usr/sbin/nologin
_chrony:x:102:102:Chrony daemon:/var/lib/chrony:/usr/sbin/nologin
tss:x:103:105:TPM software stack:/var/lib/tpm:/bin/false
uuidd:x:104:107::/run/uuidd:/usr/sbin/nologin
systemd-oom:x:989:989:systemd Userspace OOM Killer:/:/usr/sbin/nologin
whoopsie:x:105:110::/nonexistent:/bin/false
dnsmasq:x:999:65534:dnsmasq:/var/lib/misc:/usr/sbin/nologin
avahi:x:106:112:Avahi mDNS daemon:/run/avahi-daemon:/usr/sbin/nologin
nm-openvpn:x:107:113:NetworkManager OpenVPN:/var/lib/openvpn/chroot:/usr/sbin/nologin
tcpdump:x:108:114::/nonexistent:/usr/sbin/nologin
sssd:x:109:115:SSSD system user:/var/lib/sss:/usr/sbin/nologin
```



```
jashmi@Ubantu:~$ systemctl list-units --type=service --state=running
  UNIT                          LOAD   ACTIVE SUB     DESCRIPTION
  accounts-daemon.service       loaded active running Accounts Service
  apache2.service               loaded active running The Apache HTTP Server
  avahi-daemon.service          loaded active running Avahi mDNS/DNS-SD Stack
  chrony.service                loaded active running chrony, an NTP client/server
  colord.service                loaded active running Manage, Install and Generate Color Profiles
  cron.service                  loaded active running Regular background program processing daemon
  cups-browsed.service          loaded active running Make remote CUPS printers available locally
  cups.service                  loaded active running CUPS Scheduler
  dbus.service                  loaded active running D-Bus System Message Bus
  gdm.service                   loaded active running GNOME Display Manager
  ModemManager.service          loaded active running Modem Manager
  mysql.service                 loaded active running MySQL Community Server
  networkd-dispatcher.service   loaded active running Dispatcher daemon for systemd-networkd
  NetworkManager.service        loaded active running Network Manager
  polkit.service                loaded active running Authorization Manager
  power-profiles-daemon.service loaded active running Power Profiles daemon
  rsyslog.service               loaded active running System Logging Service
  rtkit-daemon.service          loaded active running RealtimeKit Scheduling Policy Service
  snapd.service                 loaded active running Snap Daemon
  switcheroo-control.service    loaded active running Switcheroo Control Proxy service
  systemd-journald.service      loaded active running Journal Service
  systemd-logind.service        loaded active running User Login Management
  systemd-oomd.service          loaded active running Userspace Out-Of-Memory (OOM) Killer
  systemd-resolved.service      loaded active running Network Name Resolution
  systemd-udevd.service         loaded active running Rule-based Manager for Device Events and Files
  udisks2.service               loaded active running Disk Manager
  unattended-upgrades.service   loaded active running Unattended Upgrades Shutdown
  upower.service                loaded active running Daemon for power management
  user@1000.service             loaded active running User Manager for UID 1000
  wpa_supplicant.service        loaded active running WPA supplicant

Legend: LOAD   → Reflects whether the unit definition was properly loaded.
        ACTIVE → The high-level unit activation state, i.e. generalization of SUB.
        SUB    → The low-level unit activation state, values depend on unit type.

30 loaded units listed.
```



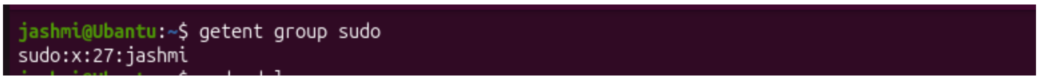
```
jashmi@Ubantu:~$ sudo ss -tulnp
[sudo: authenticate] Password:
Netid          State            Recv-Q           Send-Q                     Local Address:Port
Process
udp            UNCONN           0                0                             127.0.0.54:53
 users:(("systemd-resolve",pid=400,fd=16))
udp            UNCONN           0                0                          127.0.0.53%lo:53
 users:(("systemd-resolve",pid=400,fd=14))
udp            UNCONN           0                0                                0.0.0.0:5353
 users:(("avahi-daemon",pid=861,fd=12))
udp            UNCONN           0                0                              127.0.0.1:323
 users:(("chronyd",pid=1002,fd=4))
udp            UNCONN           0                0                                0.0.0.0:39363
 users:(("avahi-daemon",pid=861,fd=14))
udp            UNCONN           0                0                                   [::]:5353
 users:(("avahi-daemon",pid=861,fd=13))
udp            UNCONN           0                0                                   [::]:48390
 users:(("avahi-daemon",pid=861,fd=15))
udp            UNCONN           0                0                                  [::1]:323
 users:(("chronyd",pid=1002,fd=5))
tcp            LISTEN           0                4096                           127.0.0.1:631
 users:(("cupsd",pid=1471,fd=7))
tcp            LISTEN           0                151                            127.0.0.1:3306
 users:(("mysqld",pid=1573,fd=24))
tcp            LISTEN           0                4096                       127.0.0.53%lo:53
 users:(("systemd-resolve",pid=400,fd=15))
tcp            LISTEN           0                70                             127.0.0.1:33060
 users:(("mysqld",pid=1573,fd=21))
tcp            LISTEN           0                4096                          127.0.0.54:53
 users:(("systemd-resolve",pid=400,fd=17))
tcp            LISTEN           0                4096                               [::1]:631
 users:(("cupsd",pid=1471,fd=6))
tcp            LISTEN           0                511                                    *:80
 users:(("apache2",pid=1602,fd=4),("apache2",pid=1601,fd=4),("apache2",pid=1600,fd=4),("apache2",pid=1599,
id=1568,fd=4))
jashmi@Ubantu:~$
```

User Account Management

All existing user accounts were reviewed. Unnecessary or unused user accounts were removed to prevent unauthorized access.

Administrative privileges were restricted based on the principle of least privilege, ensuring that only authorized users were granted sudo access.

Outcome:
Reduced risk of unauthorized access and privilege misuse.



```
jashmi@Ubantu:~$ getent group sudo
sudo:x:27:jashmi
```

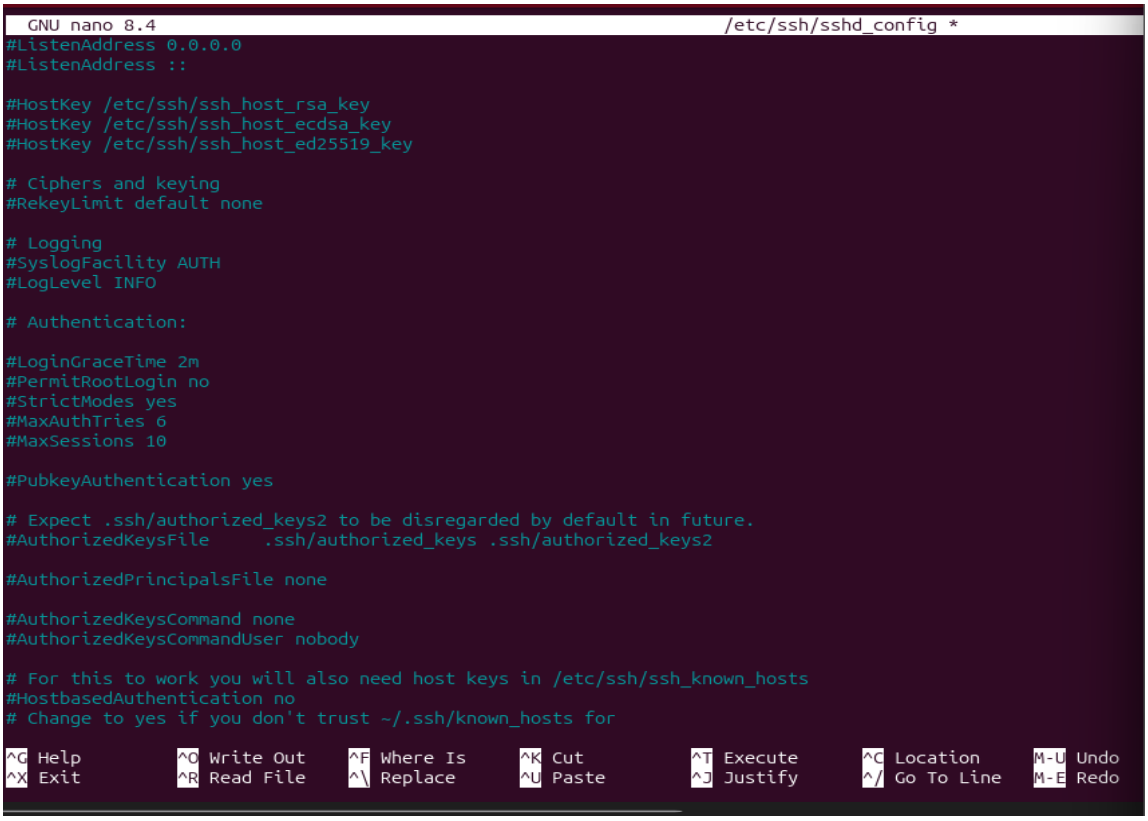
SSH Configuration and Root Login Restriction

Secure Shell (SSH) configuration was strengthened by disabling root login to prevent direct administrative access.

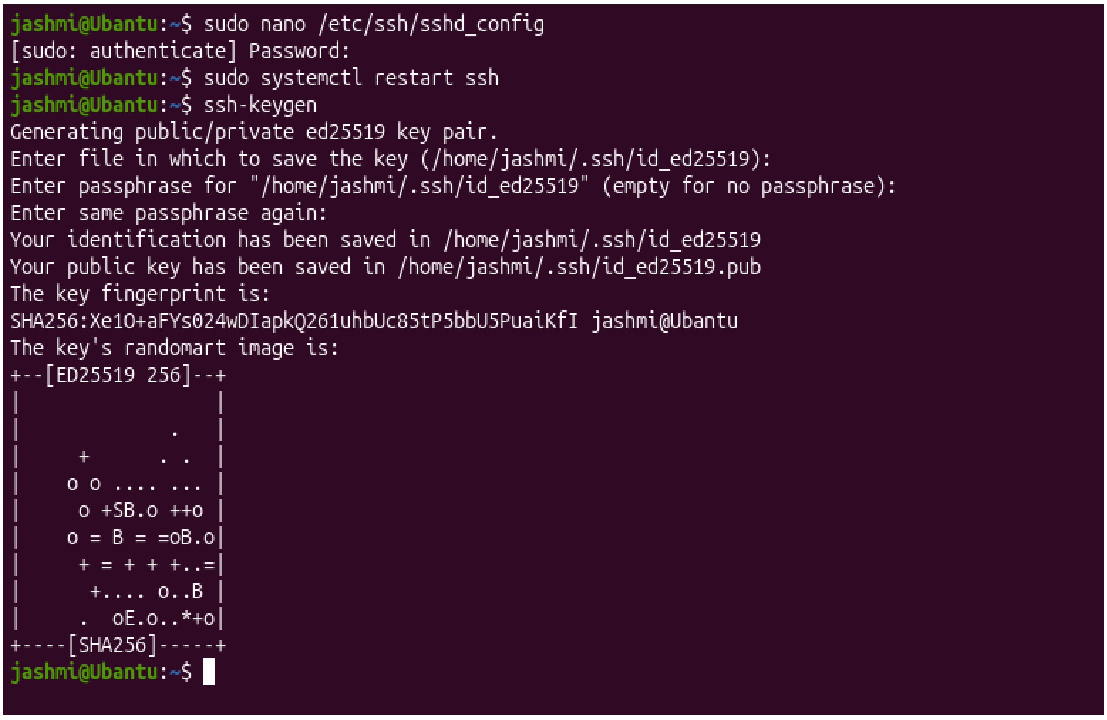
SSH key-based authentication was configured to enhance secure remote login and reduce the risk of brute-force password attacks.

Outcome:

Improved remote access security and minimized risk of root account compromise.



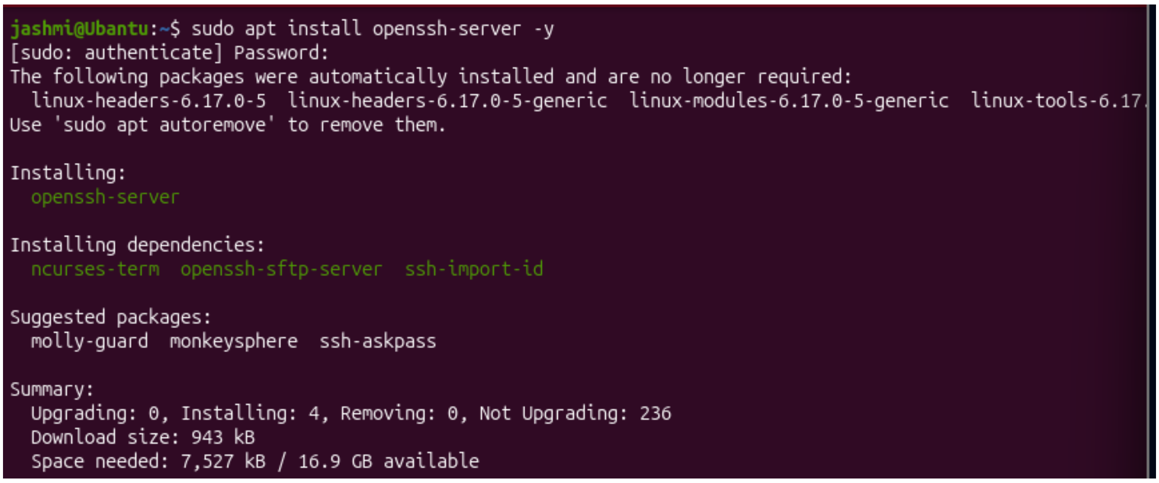
```
#ListenAddress 0.0.0.0
#ListenAddress ::

#HostKey /etc/ssh/ssh_host_rsa_key
#HostKey /etc/ssh/ssh_host_ecdsa_key
#HostKey /etc/ssh/ssh_host_ed25519_key

# Ciphers and keying
#RekeyLimit default none

# Logging
#SyslogFacility AUTH
#LogLevel INFO

# Authentication:

#LoginGraceTime 2m
#PermitRootLogin no
#StrictModes yes
#MaxAuthTries 6
#MaxSessions 10

#PubkeyAuthentication yes

# Expect .ssh/authorized_keys2 to be disregarded by default in future.
#AuthorizedKeysFile     .ssh/authorized_keys .ssh/authorized_keys2

#AuthorizedPrincipalsFile none

#AuthorizedKeysCommand none
#AuthorizedKeysCommandUser nobody

# For this to work you will also need host keys in /etc/ssh/ssh_known_hosts
#HostbasedAuthentication no
# Change to yes if you don't trust ~/.ssh/known_hosts for
```



```
jashmi@Ubantu:~$ sudo nano /etc/ssh/sshd_config
[sudo: authenticate] Password:
jashmi@Ubantu:~$ sudo systemctl restart ssh
jashmi@Ubantu:~$ ssh-keygen
Generating public/private ed25519 key pair.
Enter file in which to save the key (/home/jashmi/.ssh/id_ed25519):
Enter passphrase for "/home/jashmi/.ssh/id_ed25519" (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/jashmi/.ssh/id_ed25519
Your public key has been saved in /home/jashmi/.ssh/id_ed25519.pub
The key fingerprint is:
SHA256:Xe1O+aFYs024wDIapkQ261uhbUc85tP5bbU5PuaiKfI jashmi@Ubantu
The key's randomart image is:
+--[ED25519 256]--+
|                 |
|             .   |
|     +      . .  |
|    o o .... ... |
|     o +SB.o ++o |
|    o = B = =oB.o|
|     + = + + +..=|
|      +.... o..B |
|     .  oE.o..*+o|
+----[SHA256]-----+
jashmi@Ubantu:~$
```

System Update and Automatic Security Updates

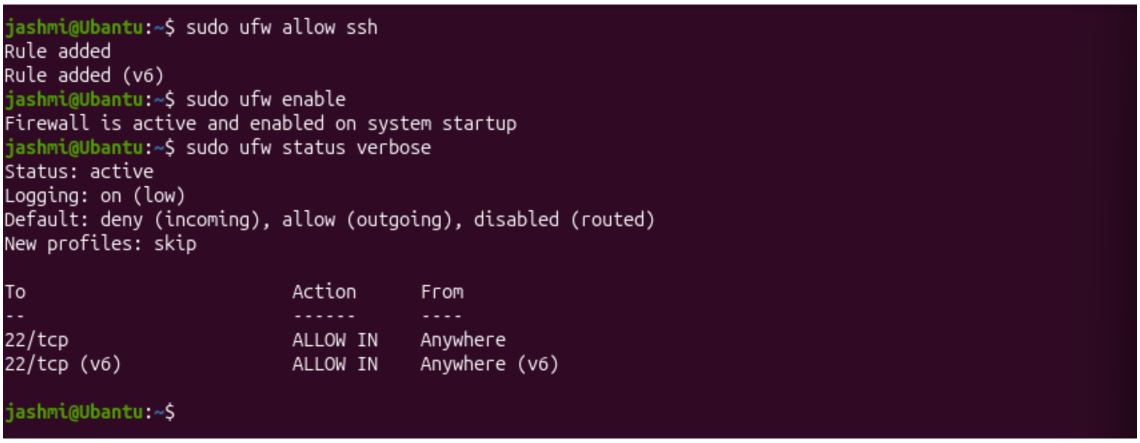
All system packages were updated using the package manager to patch known vulnerabilities.
Automatic security updates were enabled to ensure continuous protection against newly discovered threats.
Outcome:
System protected against known vulnerabilities and maintained up-to-date security patches.



```
jashmi@Ubantu:~$ sudo apt install openssh-server -y
[sudo: authenticate] Password:
The following packages were automatically installed and are no longer required:
  linux-headers-6.17.0-5  linux-headers-6.17.0-5-generic  linux-modules-6.17.0-5-generic  linux-tools-6.17.
Use 'sudo apt autoremove' to remove them.

Installing:
  openssh-server

Installing dependencies:
  ncurses-term  openssh-sftp-server  ssh-import-id

Suggested packages:
  molly-guard  monkeysphere  ssh-askpass

Summary:
  Upgrading: 0, Installing: 4, Removing: 0, Not Upgrading: 236
  Download size: 943 kB
  Space needed: 7,527 kB / 16.9 GB available
```

Firewall Configuration

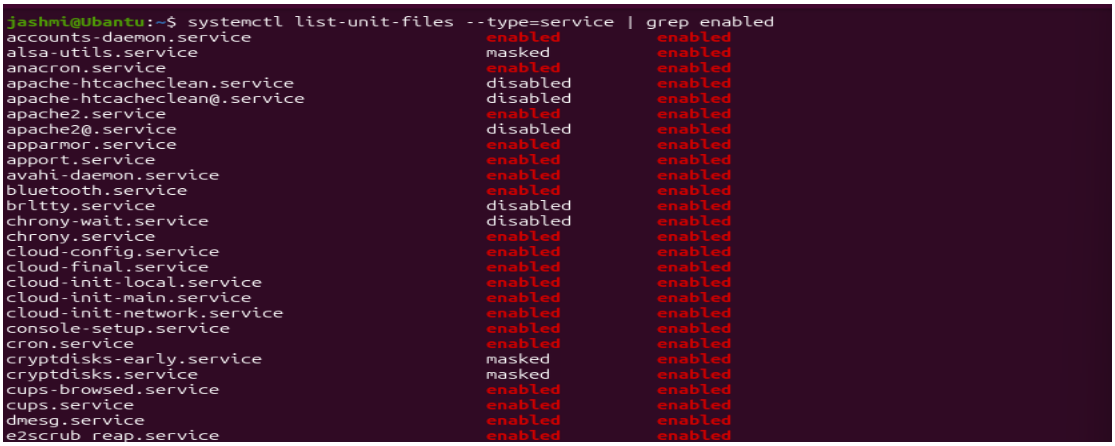
The UFW (Uncomplicated Firewall) was configured to allow only required network services such as SSH.
All unnecessary incoming connections were blocked to minimize exposure to external threats.
Outcome:
Controlled incoming and outgoing traffic and reduced network attack surface.



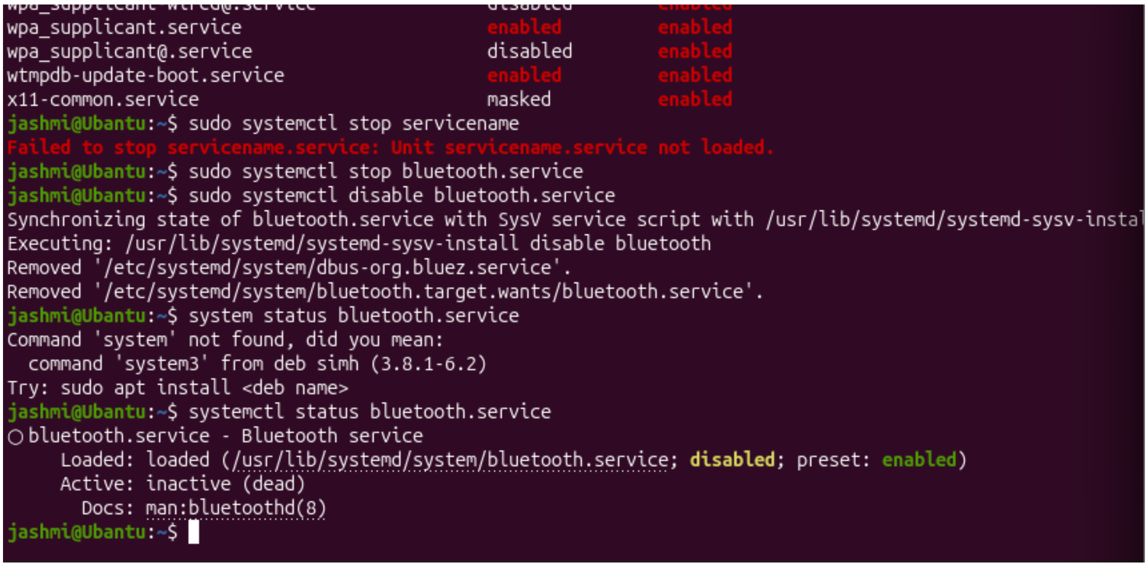
```
jashmi@Ubantu:~$ sudo ufw allow ssh
Rule added
Rule added (v6)
jashmi@Ubantu:~$ sudo ufw enable
Firewall is active and enabled on system startup
jashmi@Ubantu:~$ sudo ufw status verbose
Status: active
Logging: on (low)
Default: deny (incoming), allow (outgoing), disabled (routed)
New profiles: skip

To                         Action      From
--                         ------      ----
22/tcp                     ALLOW IN    Anywhere
22/tcp (v6)                ALLOW IN    Anywhere (v6)

jashmi@Ubantu:~$
```

Disabling Unnecessary Services

Running services were reviewed, and unnecessary services were stopped and disabled to reduce potential entry points for attackers.
This step helps in minimizing the attack surface of the server.



```
jashmi@Ubantu:~$ systemctl list-unit-files --type=service | grep enabled
accounts-daemon.service                      enabled         enabled
alsa-utils.service                           masked          enabled
anacron.service                              enabled         enabled
apache-htcacheclean.service                  disabled        enabled
apache-htcacheclean@.service                 disabled        enabled
apache2.service                              enabled         enabled
apache2@.service                             disabled        enabled
apparmor.service                             enabled         enabled
apport.service                               enabled         enabled
avahi-daemon.service                         enabled         enabled
bluetooth.service                            enabled         enabled
brltty.service                               disabled        enabled
chrony-wait.service                          disabled        enabled
chrony.service                               enabled         enabled
cloud-config.service                         enabled         enabled
cloud-final.service                          enabled         enabled
cloud-init-local.service                     enabled         enabled
cloud-init-main.service                      enabled         enabled
cloud-init-network.service                   enabled         enabled
console-setup.service                        enabled         enabled
cron.service                                 enabled         enabled
cryptdisks-early.service                     masked          enabled
cryptdisks.service                           masked          enabled
cups-browsed.service                         enabled         enabled
cups.service                                 enabled         enabled
dmesg.service                                enabled         enabled
e2scrub reap.service                         enabled         enabled
```



```
wpa_supplicant-wired@.service                disabled        enabled
wpa_supplicant.service                       enabled         enabled
wpa_supplicant@.service                      disabled        enabled
wtmpdb-update-boot.service                   enabled         enabled
x11-common.service                           masked          enabled
jashmi@Ubantu:~$ sudo systemctl stop servicename
Failed to stop servicename.service: Unit servicename.service not loaded.
jashmi@Ubantu:~$ sudo systemctl stop bluetooth.service
jashmi@Ubantu:~$ sudo systemctl disable bluetooth.service
Synchronizing state of bluetooth.service with SysV service script with /usr/lib/systemd/systemd-sysv-instal
Executing: /usr/lib/systemd/systemd-sysv-install disable bluetooth
Removed '/etc/systemd/system/dbus-org.bluez.service'.
Removed '/etc/systemd/system/bluetooth.target.wants/bluetooth.service'.
jashmi@Ubantu:~$ system status bluetooth.service
Command 'system' not found, did you mean:
  command 'system3' from deb simh (3.8.1-6.2)
Try: sudo apt install <deb name>
jashmi@Ubantu:~$ systemctl status bluetooth.service
○ bluetooth.service - Bluetooth service
     Loaded: loaded (/usr/lib/systemd/system/bluetooth.service; disabled; preset: enabled)
     Active: inactive (dead)
       Docs: man:bluetoothd(8)
jashmi@Ubantu:~$
```

File Permission Security

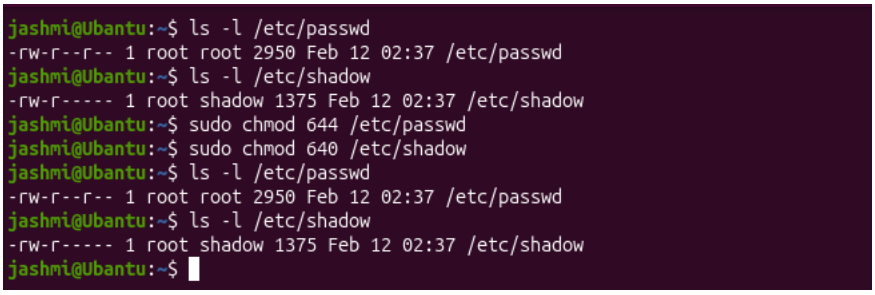
Critical system files such as:

- /etc/passwd
- /etc/shadow

were secured by configuring appropriate file permissions to prevent unauthorized access or modification.

Outcome:

Enhanced protection of sensitive authentication data.



```
jashmi@Ubantu:~$ ls -l /etc/passwd
-rw-r--r-- 1 root root 2950 Feb 12 02:37 /etc/passwd
jashmi@Ubantu:~$ ls -l /etc/shadow
-rw-r----- 1 root shadow 1375 Feb 12 02:37 /etc/shadow
jashmi@Ubantu:~$ sudo chmod 644 /etc/passwd
jashmi@Ubantu:~$ sudo chmod 640 /etc/shadow
jashmi@Ubantu:~$ ls -l /etc/passwd
-rw-r--r-- 1 root root 2950 Feb 12 02:37 /etc/passwd
jashmi@Ubantu:~$ ls -l /etc/shadow
-rw-r----- 1 root shadow 1375 Feb 12 02:37 /etc/shadow
jashmi@Ubantu:~$
```

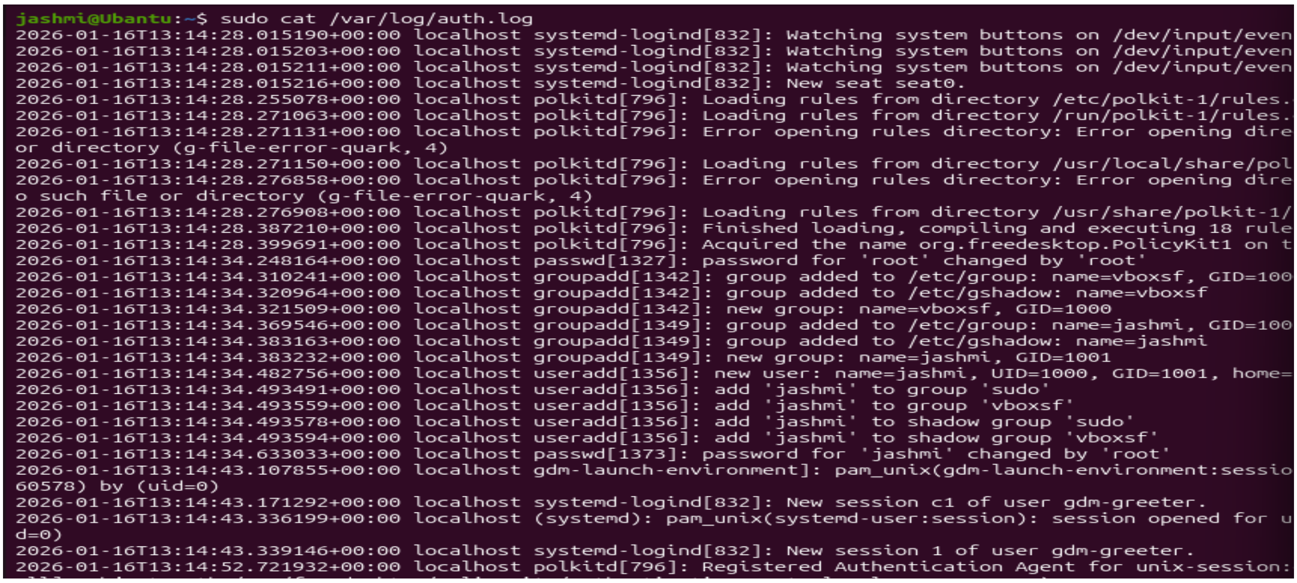
Log Monitoring and System Activity Review

System logs and authentication logs were reviewed to monitor login attempts and system activities.

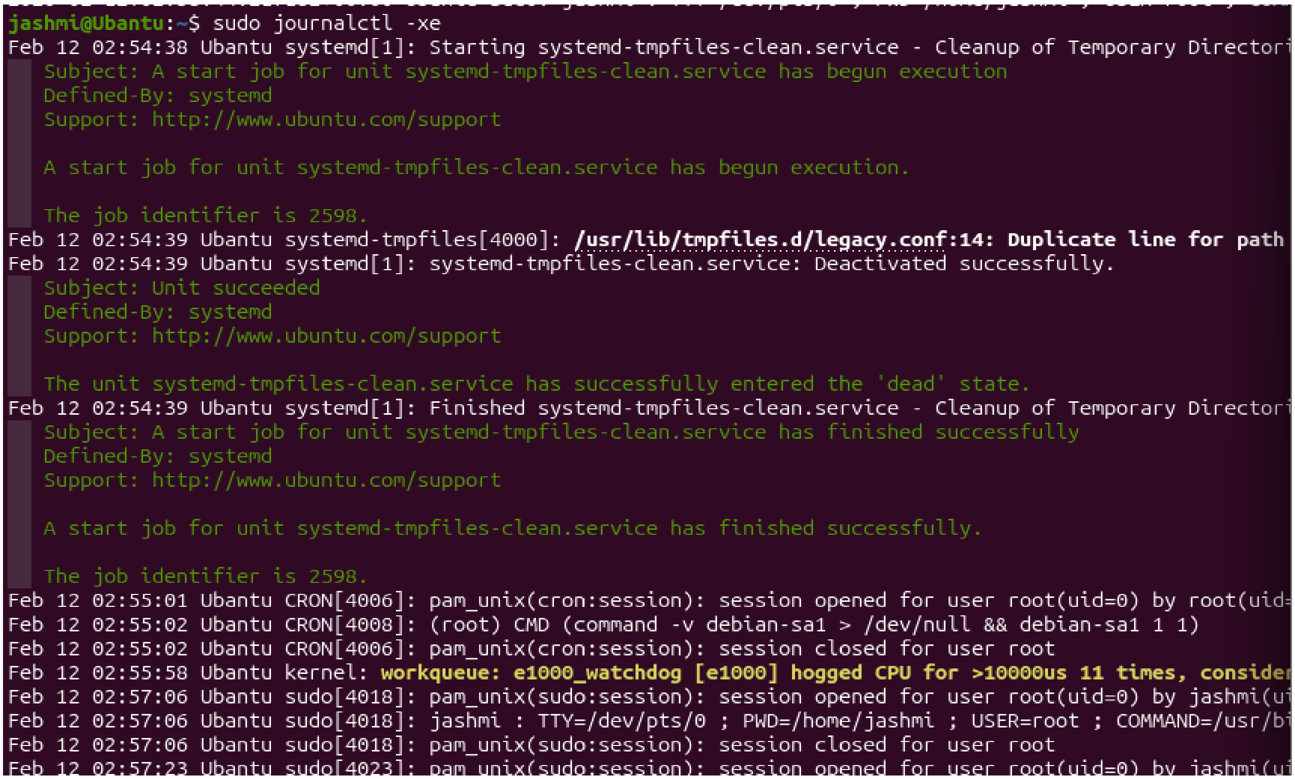
Log analysis helps in detecting suspicious behavior, failed login attempts, and potential security incidents.

Outcome:

Improved system monitoring and early detection of suspicious activities.



```
jashmi@Ubantu:~$ sudo cat /var/log/auth.log
2026-01-16T13:14:28.015190+00:00 localhost systemd-logind[832]: Watching system buttons on /dev/input/even
2026-01-16T13:14:28.015203+00:00 localhost systemd-logind[832]: Watching system buttons on /dev/input/even
2026-01-16T13:14:28.015211+00:00 localhost systemd-logind[832]: Watching system buttons on /dev/input/even
2026-01-16T13:14:28.015216+00:00 localhost systemd-logind[832]: New seat seat0.
2026-01-16T13:14:28.255078+00:00 localhost polkitd[796]: Loading rules from directory /etc/polkit-1/rules.
2026-01-16T13:14:28.271063+00:00 localhost polkitd[796]: Loading rules from directory /run/polkit-1/rules.
2026-01-16T13:14:28.271131+00:00 localhost polkitd[796]: Error opening rules directory: Error opening dire
or directory (g-file-error-quark, 4)
2026-01-16T13:14:28.271150+00:00 localhost polkitd[796]: Loading rules from directory /usr/local/share/pol
2026-01-16T13:14:28.276858+00:00 localhost polkitd[796]: Error opening rules directory: Error opening dire
o such file or directory (g-file-error-quark, 4)
2026-01-16T13:14:28.276908+00:00 localhost polkitd[796]: Loading rules from directory /usr/share/polkit-1/
2026-01-16T13:14:28.387210+00:00 localhost polkitd[796]: Finished loading, compiling and executing 18 rule
2026-01-16T13:14:28.399691+00:00 localhost polkitd[796]: Acquired the name org.freedesktop.PolicyKit1 on t
2026-01-16T13:14:34.248164+00:00 localhost passwd[1327]: password for 'root' changed by 'root'
2026-01-16T13:14:34.310241+00:00 localhost groupadd[1342]: group added to /etc/group: name=vboxsf, GID=100
2026-01-16T13:14:34.320964+00:00 localhost groupadd[1342]: group added to /etc/gshadow: name=vboxsf
2026-01-16T13:14:34.321509+00:00 localhost groupadd[1342]: new group: name=vboxsf, GID=1000
2026-01-16T13:14:34.369546+00:00 localhost groupadd[1349]: group added to /etc/group: name=jashmi, GID=100
2026-01-16T13:14:34.383163+00:00 localhost groupadd[1349]: group added to /etc/gshadow: name=jashmi
2026-01-16T13:14:34.383232+00:00 localhost groupadd[1349]: new group: name=jashmi, GID=1001
2026-01-16T13:14:34.482756+00:00 localhost useradd[1356]: new user: name=jashmi, UID=1000, GID=1001, home=
2026-01-16T13:14:34.493491+00:00 localhost useradd[1356]: add 'jashmi' to group 'sudo'
2026-01-16T13:14:34.493559+00:00 localhost useradd[1356]: add 'jashmi' to group 'vboxsf'
2026-01-16T13:14:34.493578+00:00 localhost useradd[1356]: add 'jashmi' to shadow group 'sudo'
2026-01-16T13:14:34.493594+00:00 localhost useradd[1356]: add 'jashmi' to shadow group 'vboxsf'
2026-01-16T13:14:34.633033+00:00 localhost passwd[1373]: password for 'jashmi' changed by 'root'
2026-01-16T13:14:43.107855+00:00 localhost gdm-launch-environment]: pam_unix(gdm-launch-environment:sessio
60578) by (uid=0)
2026-01-16T13:14:43.171292+00:00 localhost systemd-logind[832]: New session c1 of user gdm-greeter.
2026-01-16T13:14:43.336199+00:00 localhost (systemd): pam_unix(systemd-user:session): session opened for u
d=0)
2026-01-16T13:14:43.339146+00:00 localhost systemd-logind[832]: New session 1 of user gdm-greeter.
2026-01-16T13:14:52.721932+00:00 localhost polkitd[796]: Registered Authentication Agent for unix-session:
```



```
jashmi@Ubantu:~$ sudo journalctl -xe
Feb 12 02:54:38 Ubantu systemd[1]: Starting systemd-tmpfiles-clean.service - Cleanup of Temporary Directori
   Subject: A start job for unit systemd-tmpfiles-clean.service has begun execution
   Defined-By: systemd
   Support: http://www.ubuntu.com/support

   A start job for unit systemd-tmpfiles-clean.service has begun execution.

   The job identifier is 2598.
Feb 12 02:54:39 Ubantu systemd-tmpfiles[4000]: /usr/lib/tmpfiles.d/legacy.conf:14: Duplicate line for path
Feb 12 02:54:39 Ubantu systemd[1]: systemd-tmpfiles-clean.service: Deactivated successfully.
   Subject: Unit succeeded
   Defined-By: systemd
   Support: http://www.ubuntu.com/support

   The unit systemd-tmpfiles-clean.service has successfully entered the 'dead' state.
Feb 12 02:54:39 Ubantu systemd[1]: Finished systemd-tmpfiles-clean.service - Cleanup of Temporary Directori
   Subject: A start job for unit systemd-tmpfiles-clean.service has finished successfully
   Defined-By: systemd
   Support: http://www.ubuntu.com/support

   A start job for unit systemd-tmpfiles-clean.service has finished successfully.

   The job identifier is 2598.
Feb 12 02:55:01 Ubantu CRON[4006]: pam_unix(cron:session): session opened for user root(uid=0) by root(uid=
Feb 12 02:55:02 Ubantu CRON[4008]: (root) CMD (command -v debian-sa1 > /dev/null && debian-sa1 1 1)
Feb 12 02:55:02 Ubantu CRON[4006]: pam_unix(cron:session): session closed for user root
Feb 12 02:55:58 Ubantu kernel: workqueue: e1000_watchdog [e1000] hogged CPU for >10000us 11 times, consider
Feb 12 02:57:06 Ubantu sudo[4018]: pam_unix(sudo:session): session opened for user root(uid=0) by jashmi(ui
Feb 12 02:57:06 Ubantu sudo[4018]: jashmi : TTY=/dev/pts/0 ; PWD=/home/jashmi ; USER=root ; COMMAND=/usr/bi
Feb 12 02:57:06 Ubantu sudo[4018]: pam_unix(sudo:session): session closed for user root
Feb 12 02:57:23 Ubantu sudo[4023]: pam_unix(sudo:session): session opened for user root(uid=0) by jashmi(ui
```

Linux Hardening Checklist

✓ System updated with latest patches

✓ Automatic updates enabled

✓ Unnecessary users removed

✓ Sudo access restricted

✓ Strong password policy configured

✓ Root login disabled

✓ SSH secured

✓ Firewall enabled and configured

✓ Unnecessary services disabled

✓ File permissions secured

✓ Fail2Ban installed

✓ Lynis audit completed

Security Configuration Summary

The Ubuntu server installed in VirtualBox was successfully hardened by applying security best practices. User access was restricted following the principle of least privilege. Root login was disabled to prevent unauthorized administrative access.

Network security was enhanced through firewall configuration, and unnecessary services were disabled to minimize the attack surface. Strong password policies were enforced to improve authentication security.

Intrusion prevention mechanisms such as Fail2Ban were implemented to protect against brute-force attacks.

Finally, a comprehensive security audit was conducted using Lynis to ensure the system meets recommended security standards.

The system is now configured with improved security, reduced vulnerabilities, and enhanced monitoring capabilities.