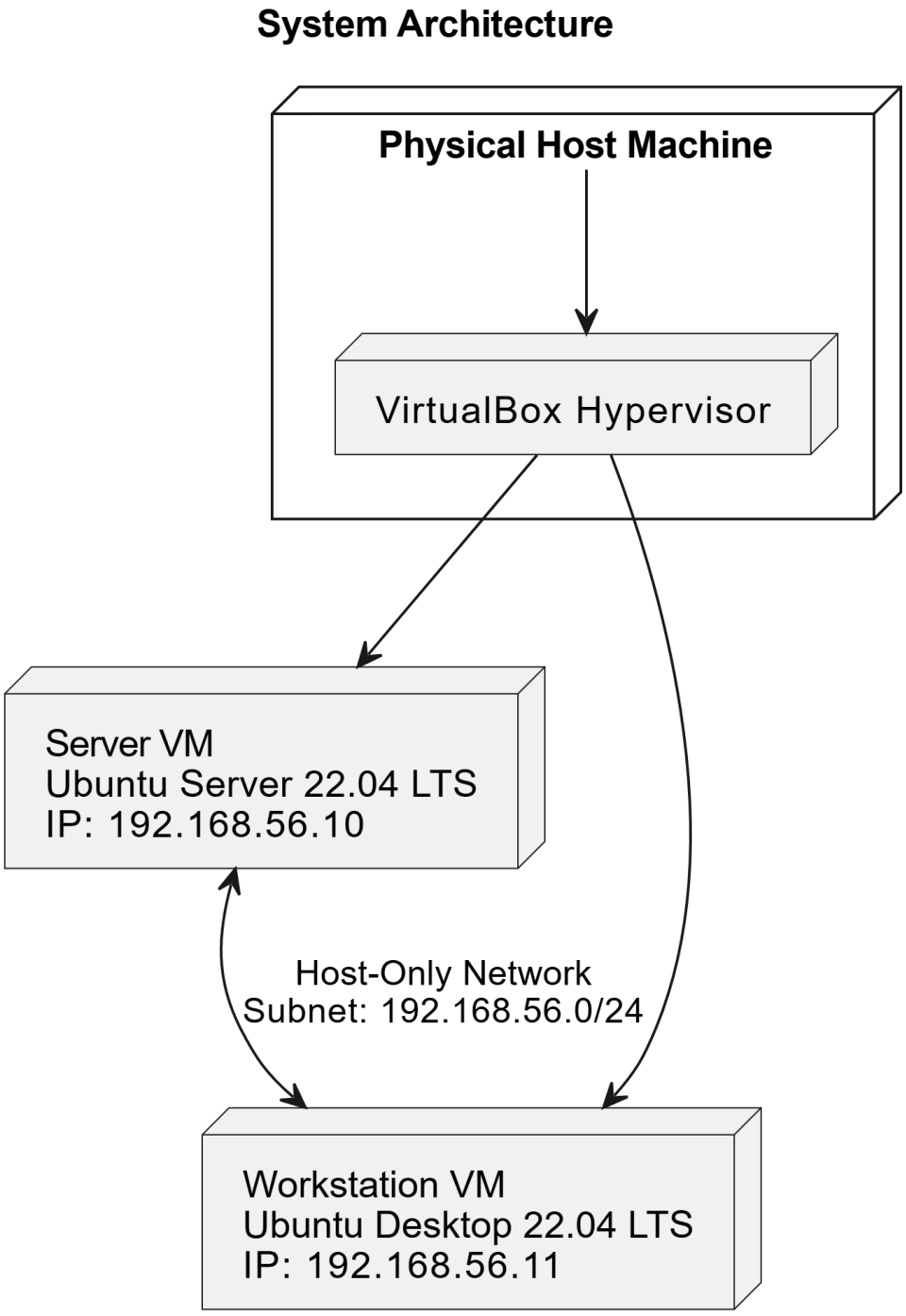
System Architecture Diagram



Distribution Selection Justification

Distribution	Family	Package Manager	Stability & Lifecycle	Use Case Fit
Ubuntu Server 22.04 LTS	Debian	apt	**High** (LTS: 5 years security updates)	**Excellent.** Widely used in education & cloud. Huge documentation base.
Debian 12 (Bookworm)	Debian	apt	**Very High** (Strict testing, extremely stable)	**Good**, but software packages can be older than in Ubuntu.
CentOS Stream 9	Red Hat	dnf/rpm	**Medium** (Rolling-release upstream for RHEL)	**Moderate.** Moving from stable to rolling release makes it less predictable for beginners.
Fedora Server 40	Red Hat	dnf/rpm	**Moderate** (Short lifecycle ~13 months)	**Low.** Frequent updates require more maintenance (bleeding edge).
openSUSE Leap 15.6	SUSE	zypper	**High** (Enterprise codebase)	**Good**, but smaller community support compared to Ubuntu/Debian.

Selected Distribution: Ubuntu Server 22.04 LTS

Rationale: Ubuntu Server 22.04 LTS was selected as the optimal OS for this coursework due to the following reasons:

1. **Stability & Support:** The Long-Term Support (LTS) release guarantees security updates for 5 years. Unlike **Fedora** (which has a short lifecycle) or **CentOS Stream** (which is a rolling release), Ubuntu LTS provides a stable environment where updates are unlikely to break configurations.

2. **Package Management:** Being part of the Debian family, it uses the apt package manager, which is renowned for its ease of use and robust dependency resolution compared to rpm-based systems for beginners.

3. **Documentation & Community:** Ubuntu has one of the largest user communities. This ensures that troubleshooting documentation for common tasks (SSH hardening, firewall configuration) is readily available.

4. **Resource Efficiency:** The headless server version runs efficiently under VirtualBox with minimal resources (configured with 2 GB RAM and 1 CPU core), leaving resources available for the Workstation VM.

5. **Compatibility:** It is fully compatible with the chosen Workstation VM (Ubuntu Desktop), ensuring seamless network interoperability and consistent command-line syntax across both systems.

Workstation configuration

Selected Option: Option A: Linux Desktop Virtual Machine Operating System: Ubuntu Desktop 22.04 LTS **IP Address:** 192.168.56.11 (Static)

Rationale: I have selected Option A (running a second virtual machine with a Linux Desktop environment) as my administrative workstation. This configuration provides the best balance of functionality, security, and realism for the following reasons:

1. **Complete Isolation (Security):** By using a dedicated VM as the workstation, all administrative traffic and security testing (such as port scanning with Nmap in Phase 7) remain strictly contained within the vboxnet0 Host-Only network. This ensures no accidental interaction with my physical host machine or external networks.

2. **Native Compatibility:** Since both the Server and Workstation are running Ubuntu 22.04 LTS, they share the same kernel, file system structure, and package management system (apt). This eliminates compatibility issues that often arise when using Windows (PowerShell/Putty) or macOS terminals (e.g., line ending differences or missing native Linux tools).

3. **Tool Availability:** Ubuntu Desktop comes pre-installed with essential tools required for the coursework, such as a native terminal for SSH connections, a web browser for updating the GitHub journal, and support for GUI-based monitoring tools if needed later

Network Configuration Documentation

To satisfy the security requirement of an isolated test environment, a **Host-Only Network** was implemented using the VirtualBox Network Manager. The DHCP server was explicitly disabled to enforce manual static IP assignment, ensuring consistent addressing for SSH connections and automation scripts.

4.1. VirtualBox Host-Only Network Settings

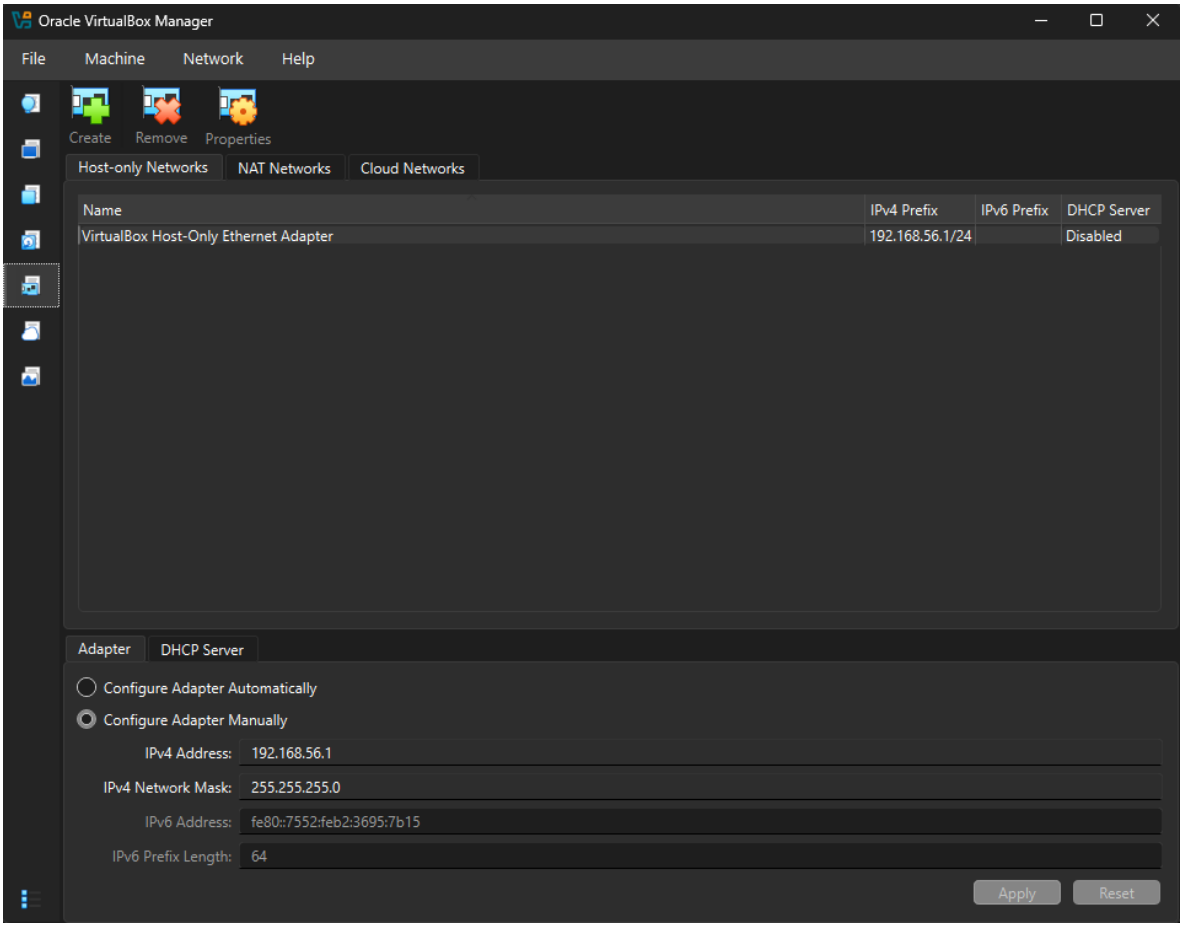
The virtualization platform was configured with a dedicated network adapter (vboxnet0) acting as the gateway for the isolated subnet.

Setting	Value	Description
Network Name	vboxnet0	Virtual interface created by VirtualBox
IPv4 Address	192.168.56.1	Gateway address (Host Machine)
IPv4 Network Mask	255.255.255.0	Defines the subnet range (/24)
DHCP Server	**Disabled**	Mandatory setting to require static IP configuration

4.2. IP Addressing Schema

Static IP addresses were manually configured within the operating system of each virtual machine using netplan (on Server) and Network Manager (on Desktop).

Device	Role	IP Address	Subnet Mask	Gateway
Physical Host	Hypervisor / Gateway	192.168.56.1	255.255.255.0	N/A
Server VM	Target System (Headless)	192.168.56.10	255.255.255.0	192.168.56.1
Workstation VM	Admin Console (Desktop)	192.168.56.11	255.255.255.0	192.168.56.1

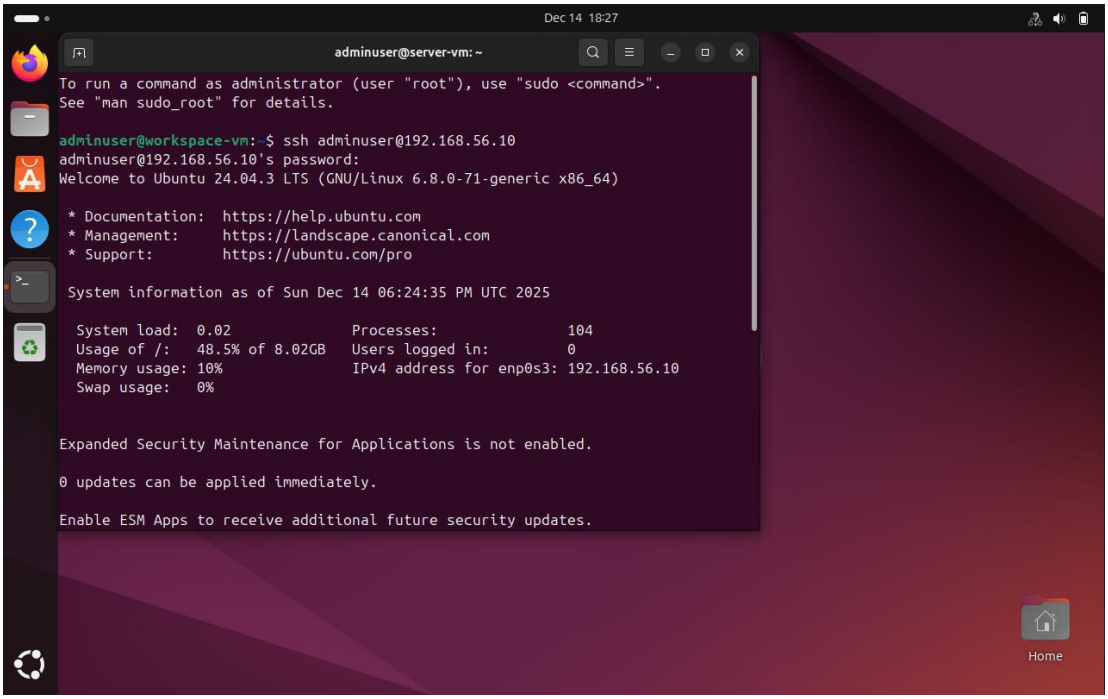



```
adminuser@server-vm:~$ ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host noprefixroute
       valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 08:00:27:96:6d:ed brd ff:ff:ff:ff:ff:ff
    inet 192.168.56.10/24 brd 192.168.56.255 scope global enp0s3
       valid_lft forever preferred_lft forever
    inet6 fe80::a00:27ff:fe96:6ded/64 scope link
       valid_lft forever preferred_lft forever
```

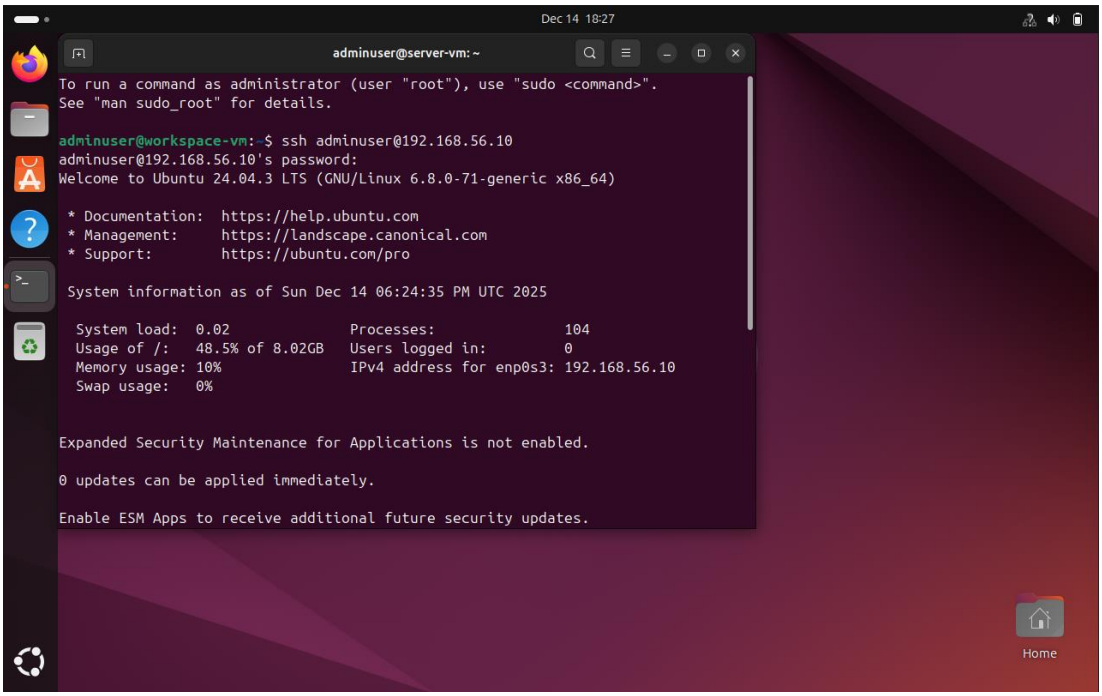
```
adminuser@workspace-vm: ~
adminuser@workspace-vm:~$ ping 192.168.56.10
PING 192.168.56.10 (192.168.56.10) 56(84) bytes of data.
64 bytes from 192.168.56.10: icmp_seq=1 ttl=64 time=2.72 ms
64 bytes from 192.168.56.10: icmp_seq=2 ttl=64 time=0.915 ms
64 bytes from 192.168.56.10: icmp_seq=3 ttl=64 time=1.04 ms
64 bytes from 192.168.56.10: icmp_seq=4 ttl=64 time=0.977 ms
64 bytes from 192.168.56.10: icmp_seq=5 ttl=64 time=1.40 ms
64 bytes from 192.168.56.10: icmp_seq=6 ttl=64 time=1.00 ms
64 bytes from 192.168.56.10: icmp_seq=7 ttl=64 time=1.25 ms
64 bytes from 192.168.56.10: icmp_seq=8 ttl=64 time=1.25 ms
64 bytes from 192.168.56.10: icmp_seq=9 ttl=64 time=1.70 ms
64 bytes from 192.168.56.10: icmp_seq=10 ttl=64 time=0.687 ms
```

System Specifications Documentation

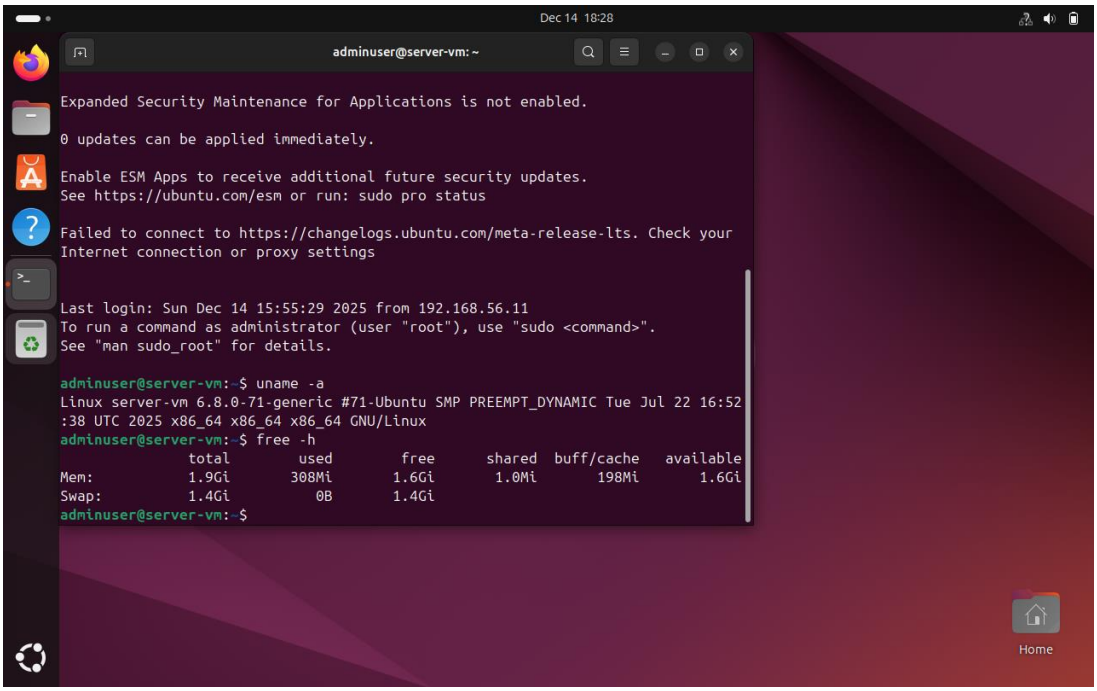
SSH connect



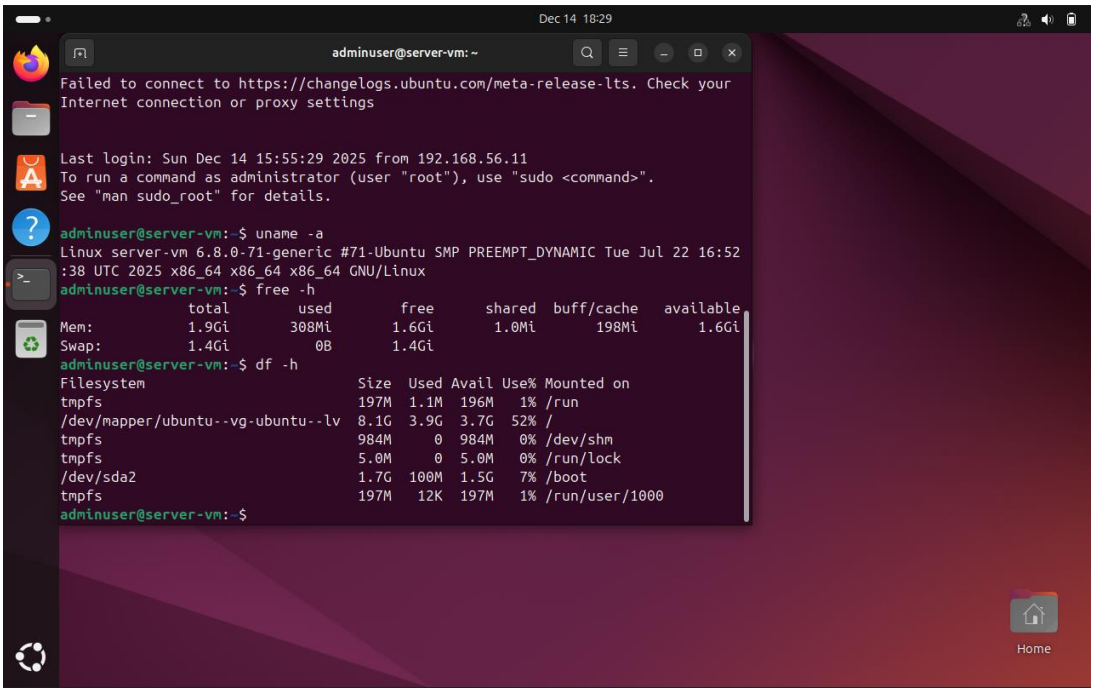
uname -a



free –h


Dec 14 18:28
adminuser@server-vm: ~
Expanded Security Maintenance for Applications is not enabled.
0 updates can be applied immediately.
Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status
Failed to connect to https://changelogs.ubuntu.com/meta-release-lts. Check your Internet connection or proxy settings
Last login: Sun Dec 14 15:55:29 2025 from 192.168.56.11
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.
adminuser@server-vm:~$ uname -a
Linux server-vm 6.8.0-71-generic #71-Ubuntu SMP PREEMPT_DYNAMIC Tue Jul 22 16:52:38 UTC 2025 x86_64 x86_64 x86_64 GNU/Linux
adminuser@server-vm:~$ free -h
total used free shared buff/cache available
Mem: 1.9Gi 308Mi 1.6Gi 1.0Mi 198Mi 1.6Gi
Swap: 1.4Gi 0B 1.4Gi
adminuser@server-vm:~$
Home

df –h


Dec 14 18:29
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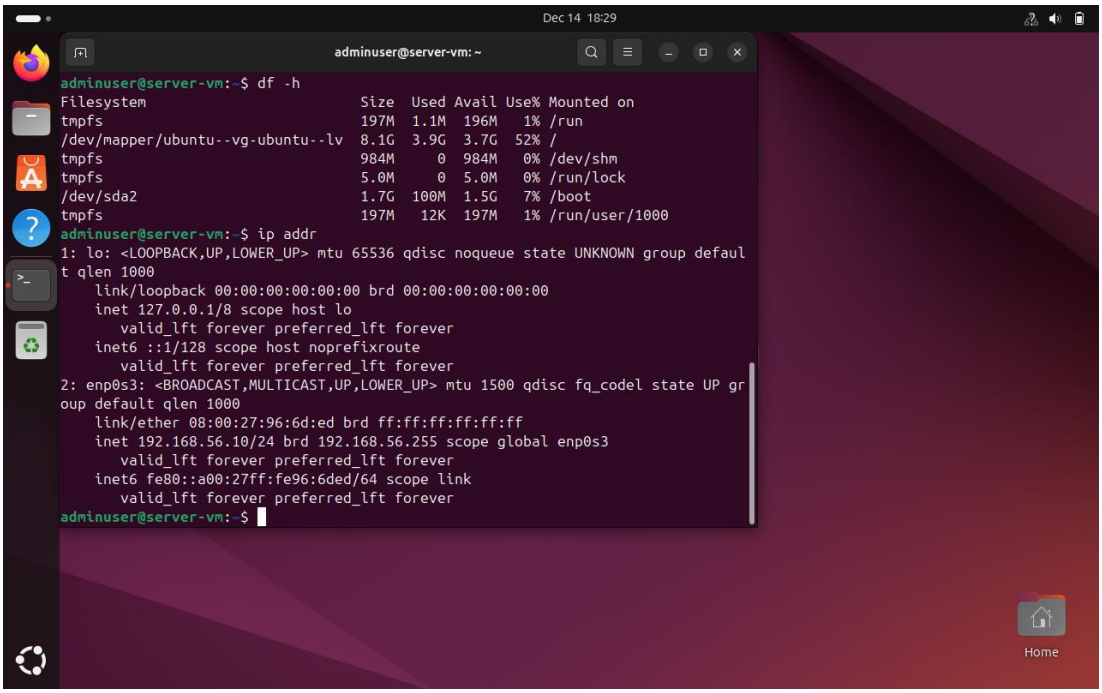
total used free shared buff/cache available
Mem: 1.9Gi 308Mi 1.6Gi 1.0Mi 198Mi 1.6Gi
Swap: 1.4Gi 0B 1.4Gi
adminuser@server-vm:~$ df -h
Filesystem Size Used Avail Use% Mounted on
tmpfs 197M 1.1M 196M 1% /run
/dev/mapper/ubuntu--vg-ubuntu--lv 8.1G 3.9G 3.7G 52% /
tmpfs 984M 0 984M 0% /dev/shm
tmpfs 5.0M 0 5.0M 0% /run/lock
/dev/sda2 1.7G 100M 1.5G 7% /boot
tmpfs 197M 12K 197M 1% /run/user/1000
adminuser@server-vm:~$
Home

ip addr



lsb_release –a