

IMPLEMENTASI DAN ANALISIS NESTED VIRTUALIZATION DENGAN PROXMOX VE PADA INFRASTRUKTUR MIKROTIK

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Latar Belakang

Virtualisasi merupakan teknologi penting untuk efisiensi sumber daya dan isolasi sistem. Nested Virtualization memungkinkan hypervisor berjalan di dalam virtual machine lain, sehingga ideal untuk simulasi lingkungan cloud, pengujian jaringan, dan pembelajaran teknologi virtualisasi tanpa memerlukan banyak perangkat fisik.

Proyek ini mengimplementasikan nested virtualization menggunakan Mikrotik sebagai router, VirtualBox sebagai hypervisor tingkat pertama, Proxmox VE sebagai hypervisor tingkat kedua, dan Ubuntu Server sebagai guest VM. Tujuannya adalah membangun lingkungan lab virtual yang terisolasi, terhubung internet, dan siap digunakan untuk eksperimen lebih lanjut.

Rumusan Masalah dan Tujuan

Rumusan Masalah :

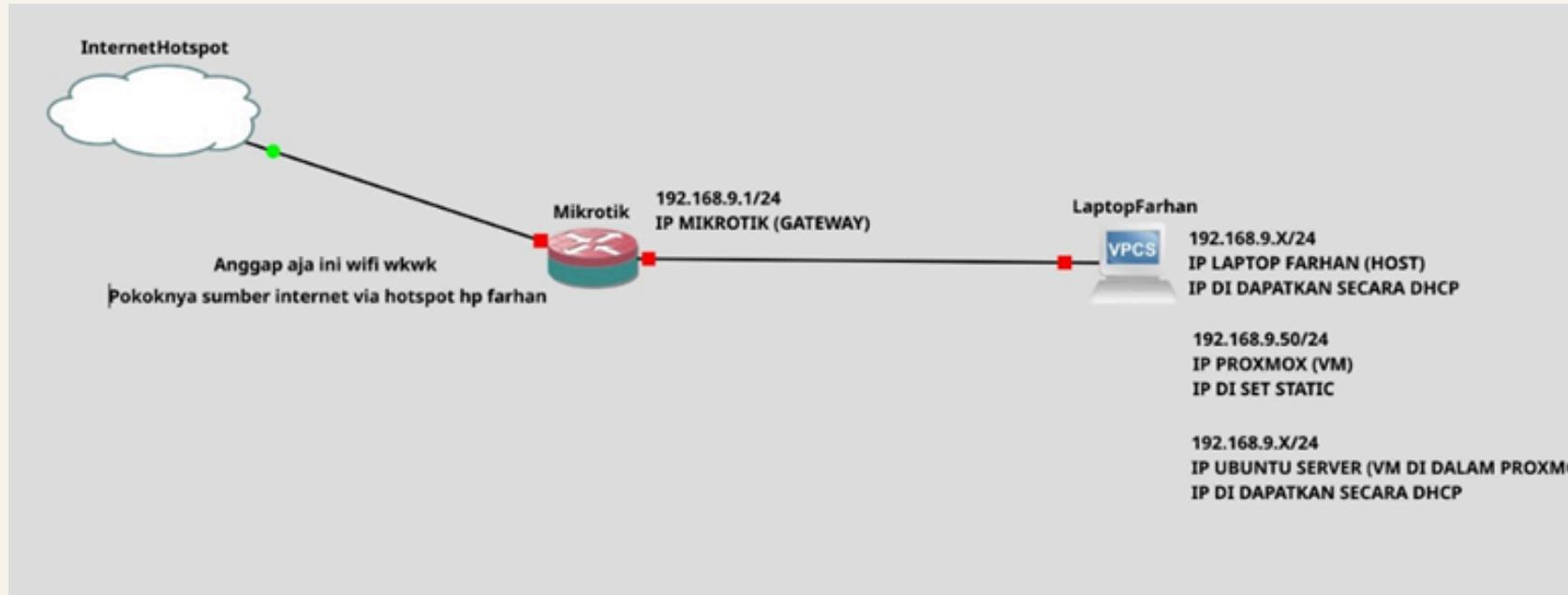
1. Bagaimana membangun jaringan lab virtual dengan Mikrotik?
2. Bagaimana konfigurasi VirtualBox untuk nested virtualization?
3. Bagaimana instalasi dan konfigurasi Proxmox VE di dalam VirtualBox?
4. Bagaimana menguji integrasi seluruh lapisan?

Tujuan :

1. Membuat jaringan 192.168.9.0/24 dengan akses internet.
2. Menyiapkan VM dengan dukungan nested virtualization.
3. Instalasi Proxmox dengan IP statis.
4. Menguji konektivitas, snapshot, backup, dan performa.

Arsitektur Sistem

Topologi Jaringan :



Arsitektur Sistem :

1. Sumber Internet: Hotspot dari HP Farhan.
2. Router/Gateway: Mikrotik dengan IP 192.168.9.1/24.
3. Jaringan Lokal: Subnet 192.168.9.0/24 yang terisolasi.
4. Host: Laptop Farhan mendapat IP via DHCP dari Mikrotik.
5. Hypervisor L2: Proxmox VE di-set dengan IP statis 192.168.9.50.
6. Guest VM: Ubuntu Server di dalam Proxmox mendapat IP via DHCP dari Mikrotik.

Konsep Konektivitas :

1. Mikrotik menghubungkan jaringan lokal ke internet via hotspot.
2. Semua perangkat (host, VM, nested VM) berada dalam subnet yang sama.
3. VirtualBox di-bridge ke jaringan fisik via USB LAN dongle.
4. Proxmox dan Ubuntu dapat diakses langsung dari host laptop.

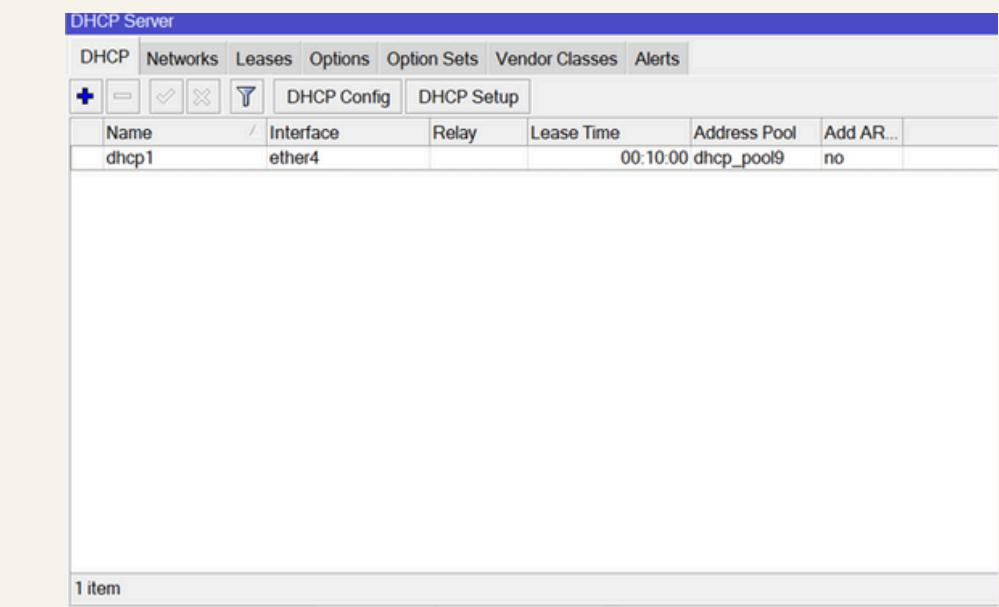
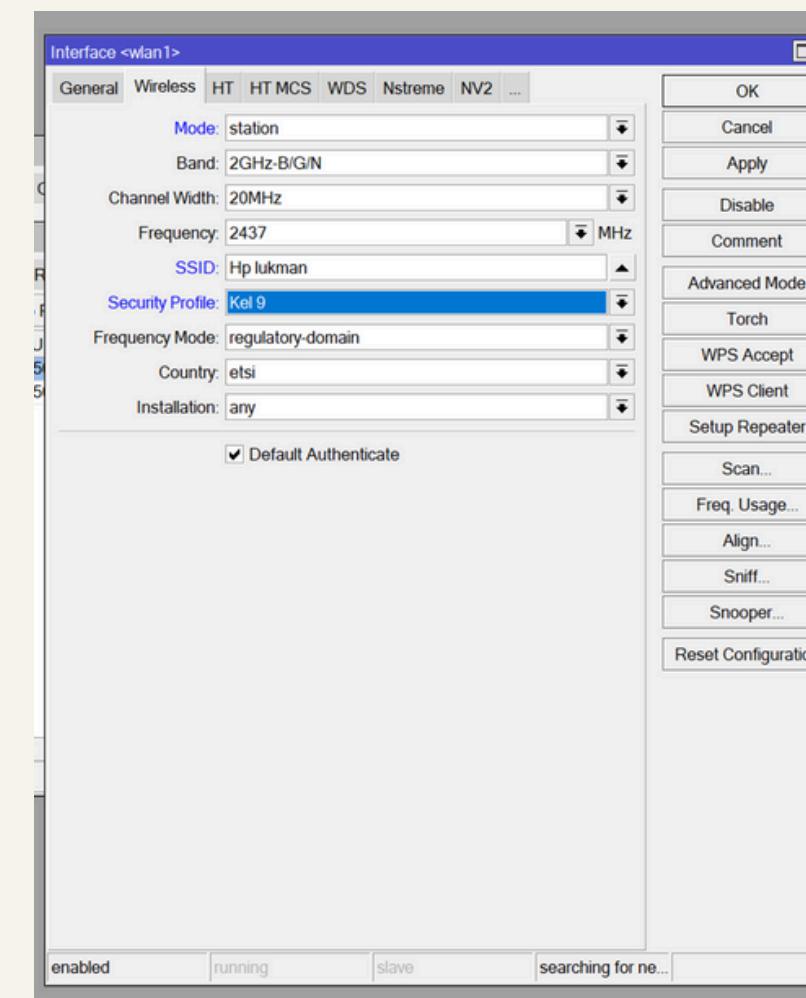
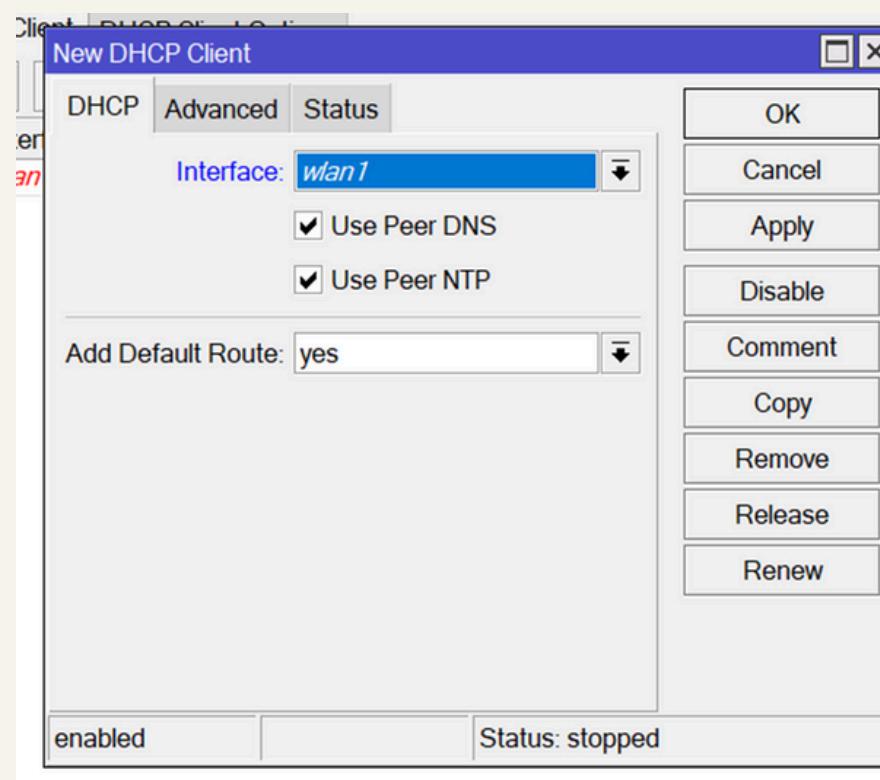
Spesifikasi Resource :

1. VirtualBox VM: 6 GB RAM, 2 Core CPU, 50 GB Disk.
2. Proxmox VE: IP Static 192.168.9.50.
3. Guest VM (Ubuntu): 2 GB RAM, 2 Core CPU (Type: Host).

Konfigurasi Mikrotik

Langkah-langkah:

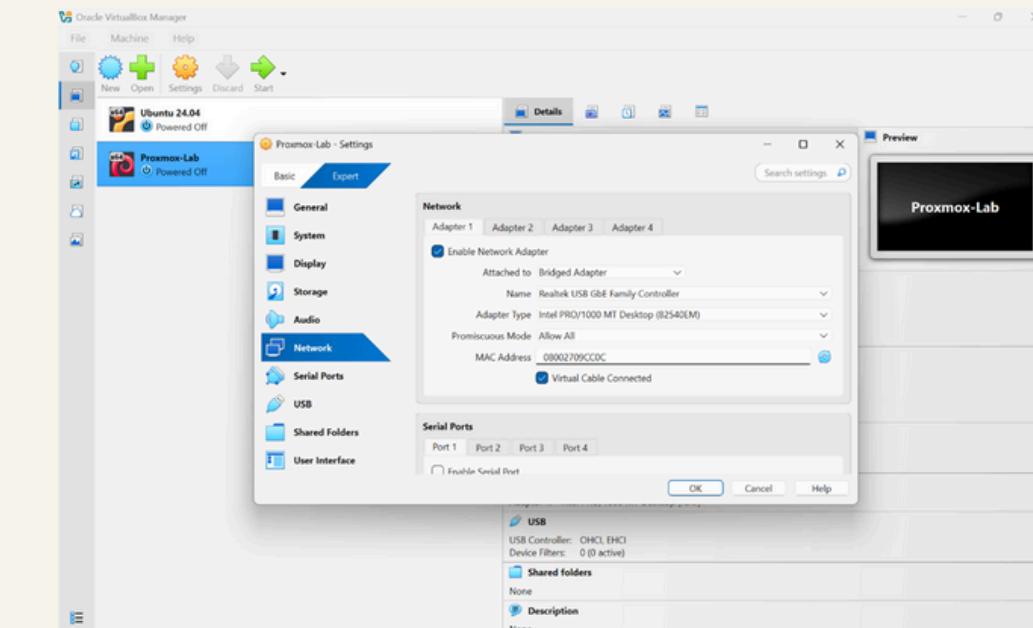
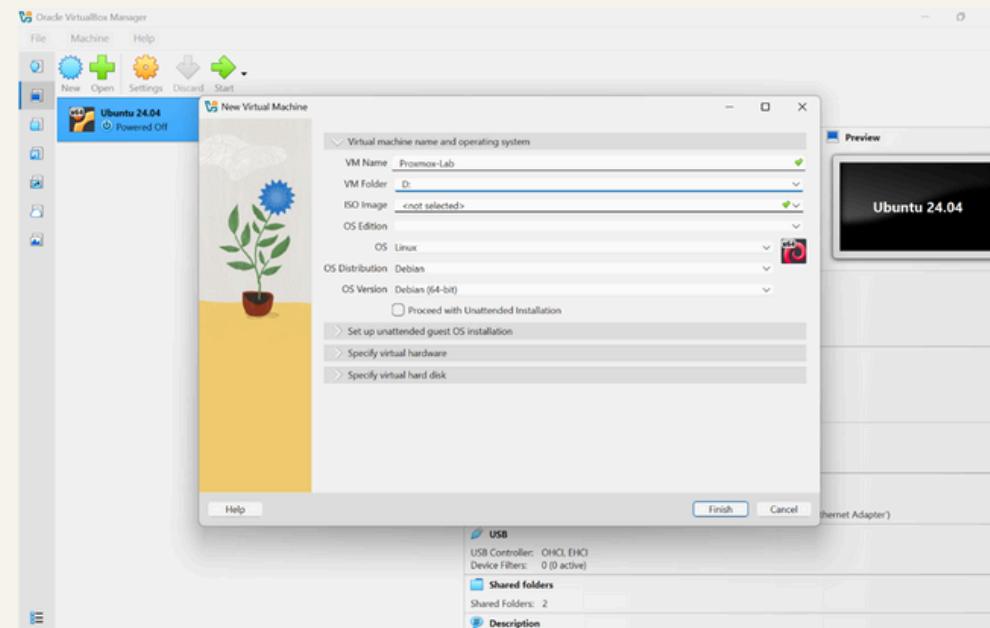
1. Setup koneksi internet via Wi-Fi (WLAN1)
2. Setup jaringan lokal pada ether5 (192.168.9.0/24)
3. Konfigurasi DHCP Server dan NAT (Masquerade)



Konfigurasi VirtualBox

Langkah-langkah:

1. Pemasangan kabel & verifikasi jaringan
2. Pembuatan VM Proxmox-Lab
3. Network Bridging ke USB LAN Dongle
4. Aktivasi AMD-V Nested via CLI



```
C:\Program Files\Oracle\VirtualBox>VBoxManage.exe modifyvm Proxmox-Lab --nested-hw-virt on
C:\Program Files\Oracle\VirtualBox>
```

A screenshot of a Windows Command Prompt window titled 'Administrator: Command Pro'. The user has run the command 'VBoxManage.exe modifyvm Proxmox-Lab --nested-hw-virt on'. The command is completed successfully, as indicated by the prompt 'C:\Program Files\Oracle\VirtualBox>'.

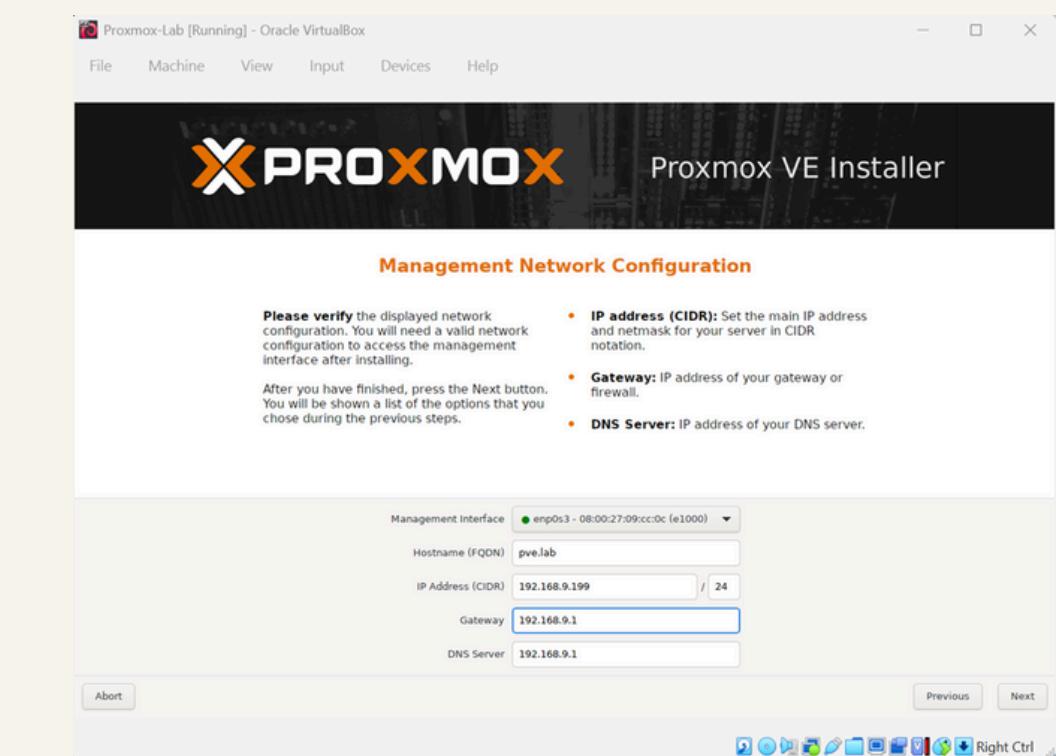
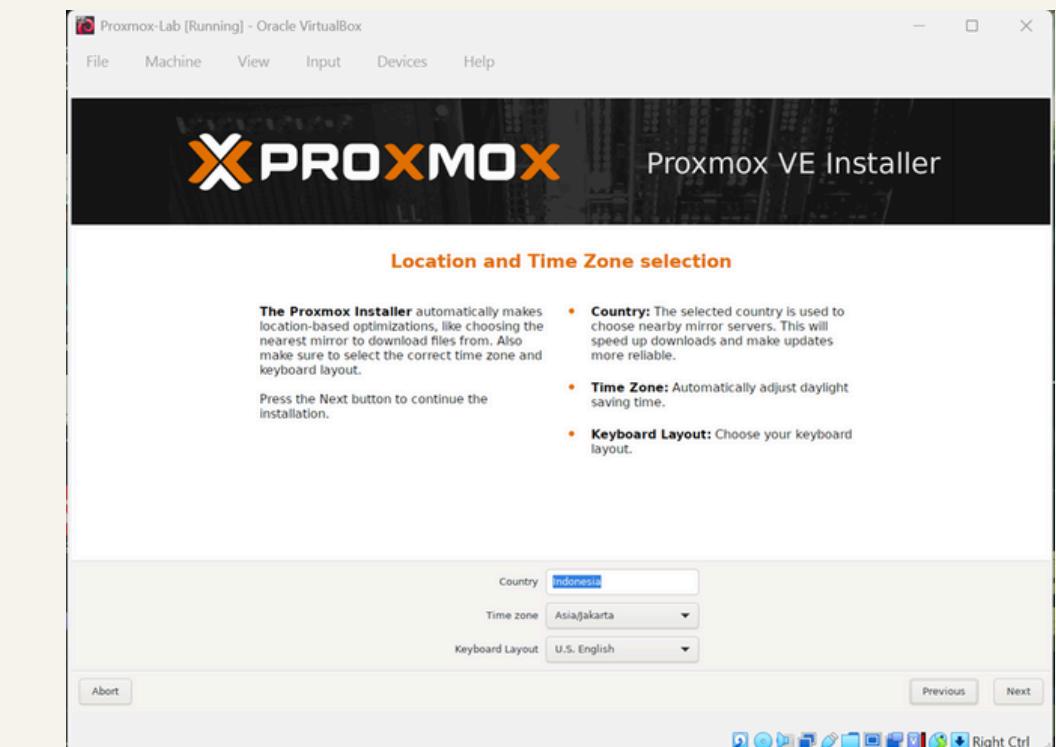
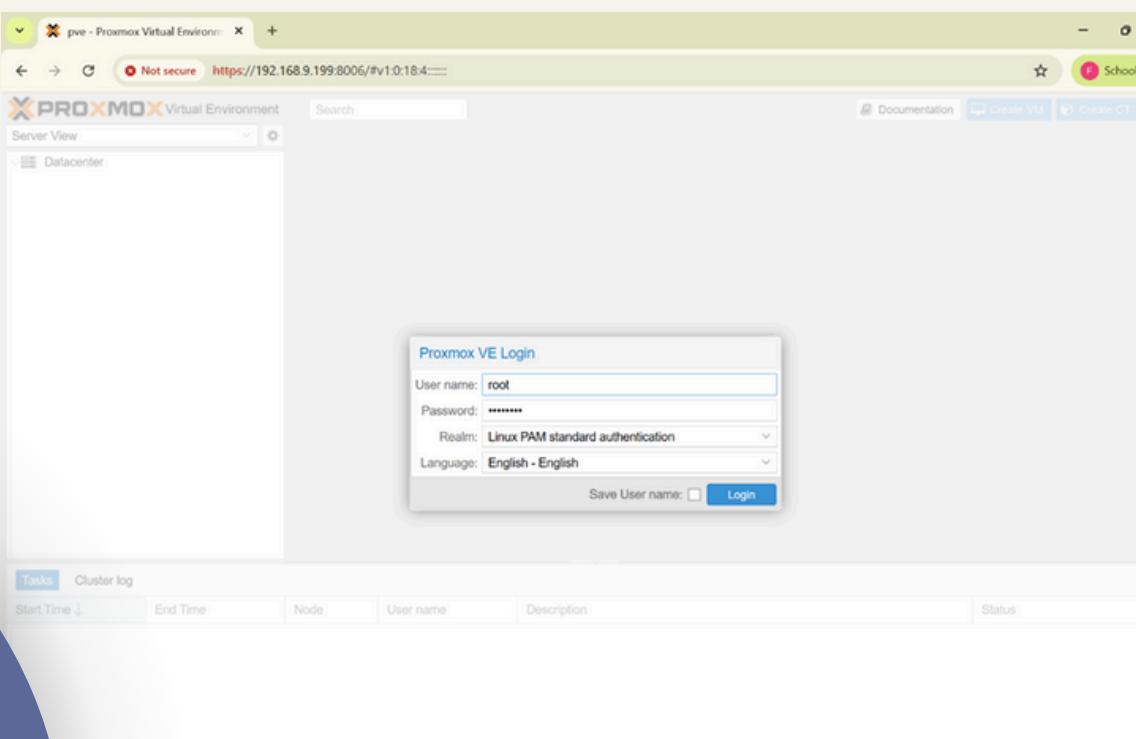
Instalasi Proxmox VE

Proses Instalasi:

- Pilih ISO Proxmox VE
- Atur IP statis: 192.168.9.50
- Gateway: 192.168.9.1
- DNS: 192.168.9.1 & 8.8.8.8

Akses:

<https://192.168.9.50:8006>



Guest VM Ubuntu

Langkah-langkah:

1. Buat VM baru di Proxmox
2. Pilih ISO Ubuntu Server
3. Atur CPU Type: Host
4. Install Ubuntu Minimal dengan OpenSSH

Create: Virtual Machine

General OS System Disks CPU Memory Network Confirm

Node: pve VM ID: 100 Name: Ubuntu-server-9

Start at boot: Start/Shutdown order: any Startup delay: default Shutdown timeout: default

Tags: No Tags +

Help Advanced Back Next

Create: Virtual Machine

General OS System Disks CPU Memory Network Confirm

Use CD/DVD disc image file (iso) Guest OS: Storage: local Type: Linux ISO image: ubuntu-22.04.5-live-se Version: 6.x - 2.6 Kernel

Use physical CD/DVD Drive

Do not use any media

Advanced Back Next

Create: Virtual Machine

General OS System Disks CPU Memory Network Confirm

Sockets: 1 Type: host Cores: 2 Total cores: 2

VCPUs: 2 CPU units: 100 CPU limit: unlimited Enable NUMA:

Extra CPU Flags:

Default	- <input type="radio"/> <input checked="" type="radio"/> + md-clear	Required to let the guest OS know if MDS is mitigated correctly
Default	- <input type="radio"/> <input checked="" type="radio"/> + pcid	Meltdown fix cost reduction on Westmere, Sandy-, and IvyBridge Intel CPUs
Default	- <input type="radio"/> <input checked="" type="radio"/> + spec-ctrl	Allows improved Spectre mitigation with Intel CPUs
Default	- <input type="radio"/> <input checked="" type="radio"/> + ssbd	Protection for "Speculative Store Bypass" for Intel models
Default	- <input type="radio"/> <input checked="" type="radio"/> + ibpb	Allows improved Spectre mitigation with AMD CPUs
Default	- <input type="radio"/> <input checked="" type="radio"/> + virt-ssbd	Basis for "Speculative Store Bypass" protection for AMD models

Help Advanced Back Next

Choose the type of installation

Choose the base for the installation.

() Ubuntu Server
The default install contains a curated set of packages that provide a comfortable experience for operating your server.

(X) Ubuntu Server (minimized)
This version has been customized to have a small runtime footprint in environments where humans are not expected to log in.

Additional options

[] Search for third-party drivers
This software is subject to license terms included with its documentation. Some is proprietary. Third-party drivers should not be installed on systems that will be used for FIPS or the real-time kernel.

Done Back

SSH configuration

You can choose to install the OpenSSH server package to enable secure remote access to your server.

[X] Install OpenSSH server

[X] Allow password authentication over SSH

[Import SSH key ▾]

AUTHORIZED KEYS
No authorized key

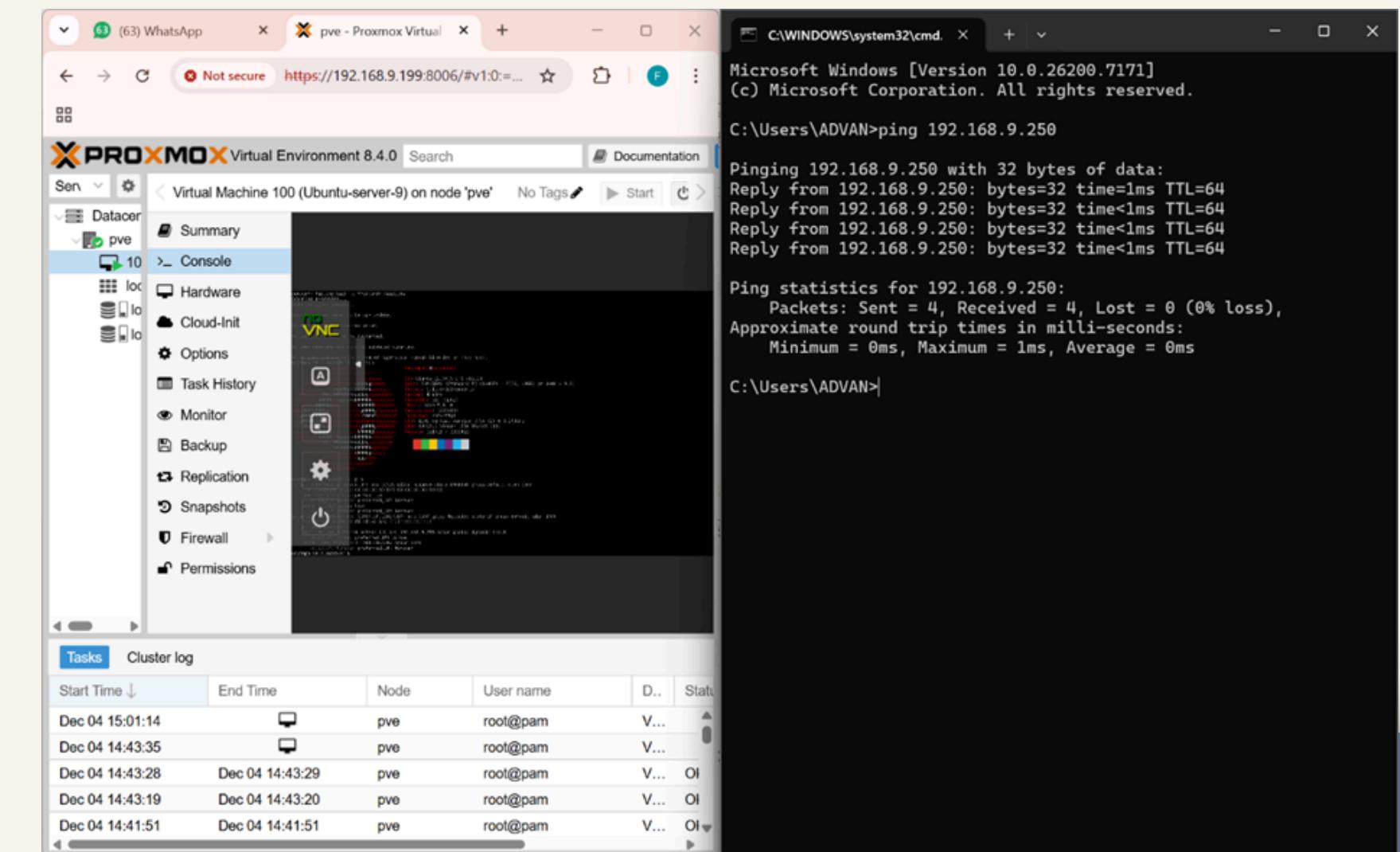
Done Back

Uji Integrasi Jaringan

Skenario: Ping dari laptop ke VM Ubuntu

Hasil: Reply dari 192.168.9.253

Kesimpulan: Jaringan multilayer
berfungsi dengan baik.



Uji Snapshot & Rollback

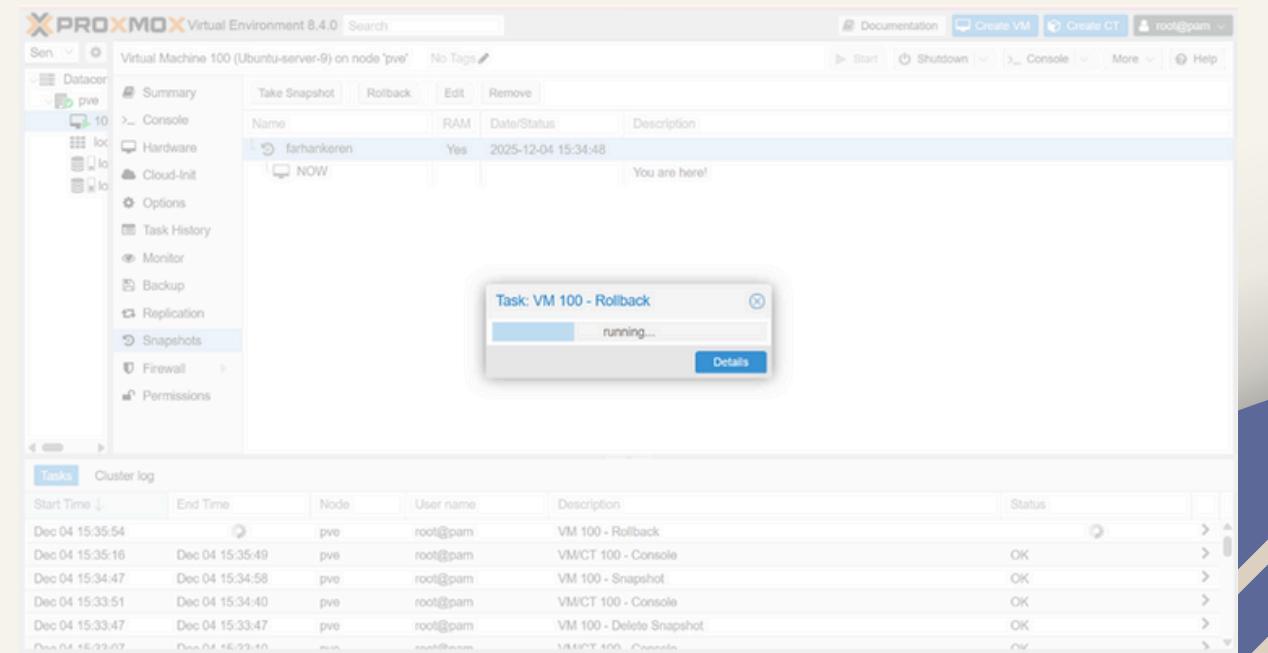
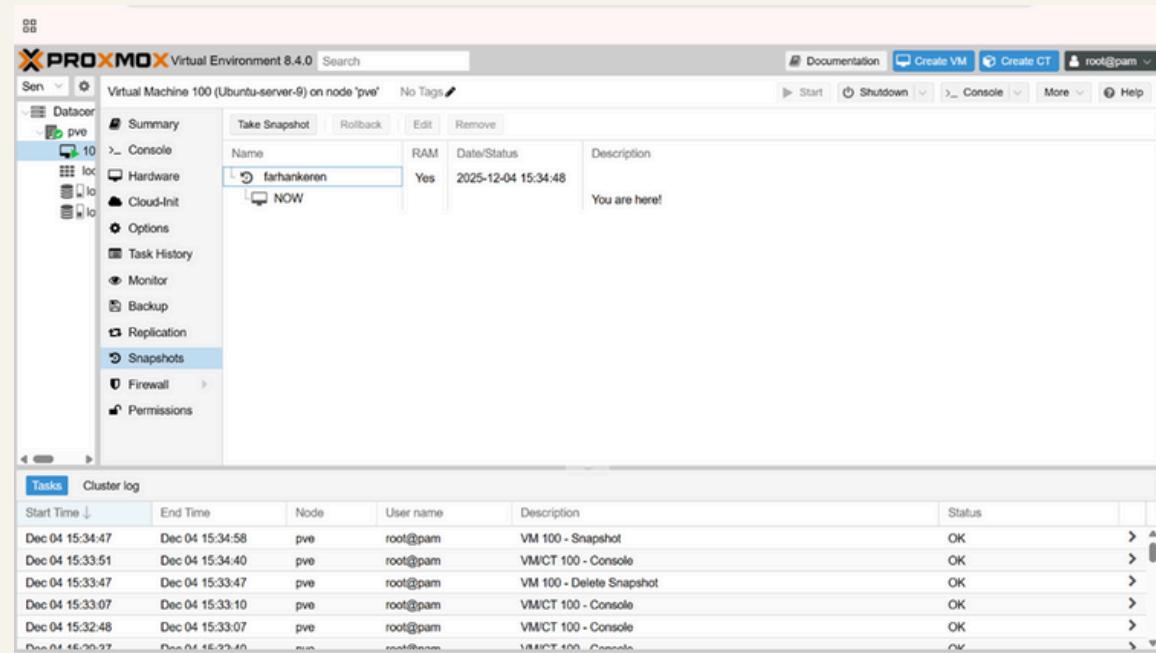
Skenario:

1. Buat file fakta.txt di Ubuntu
2. Ambil snapshot di Proxmox
3. Hapus file
4. Rollback snapshot

Hasil: File kembali muncul

Kesimpulan: Fitur snapshot/rollback berjalan normal.

```
kelompok9@kelompok9:~$ echo "farhankeren" > fakta.txt
kelompok9@kelompok9:~$ rm fakta.txt
kelompok9@kelompok9:~$
```

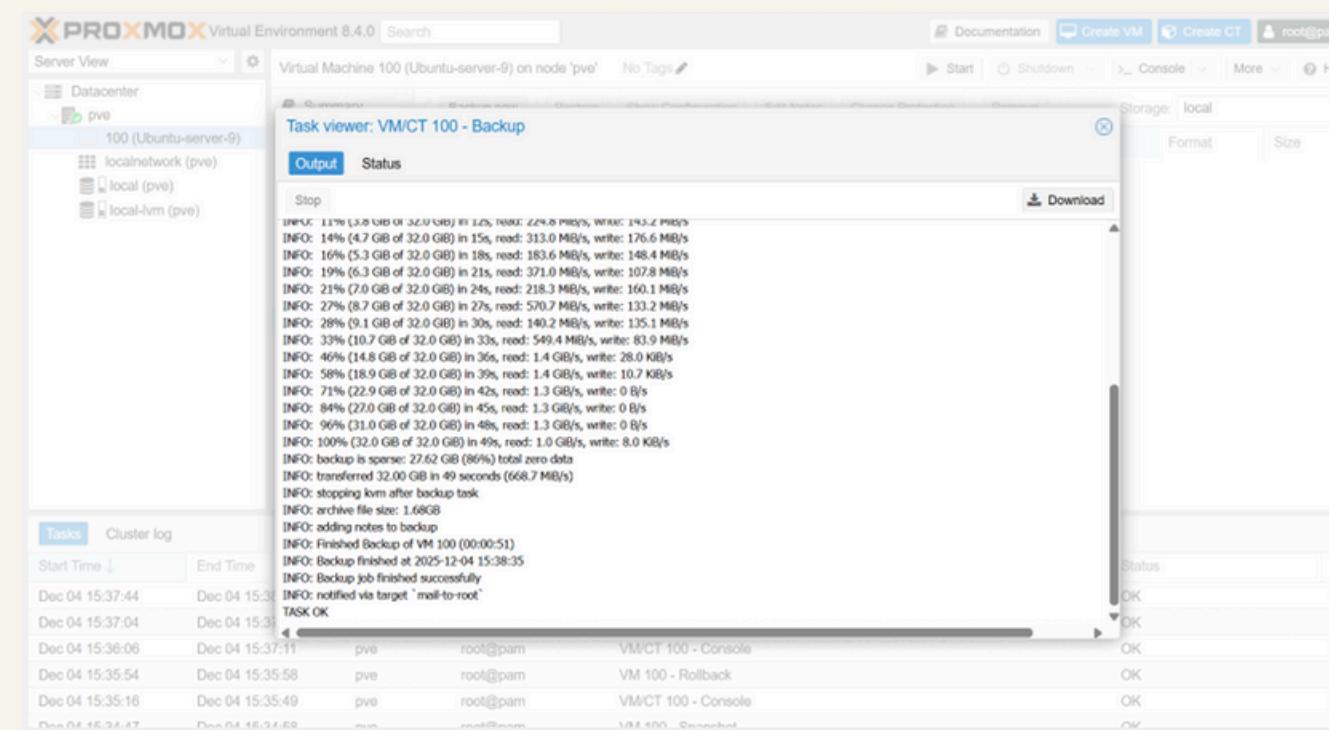


Uji Backup

Skenario: Backup VM Ubuntu dengan mode stop

Hasil: Log TASK OK, file backup tersimpan

Kesimpulan: Backup berhasil dilakukan.



Backup VM 100 (Ubuntu-server-9)

Storage: local
Mode: Stop
Protected:
Compression: ZSTD (fast and good)
Notification mode: Auto
Send email to: none

PBS change detection mode: Default

Notes: {{guestname}}

Possible template variables are: {{cluster}}, {{guestname}}, {{node}}, {{vmid}}

Help

Backup

Server View

Virtual Machine 100 (Ubuntu-server-9) on node 'pve' No Tags

Summary Backup now Restore Show Configuration Edit Notes Change Protection Remove Storage: local

Name: vzdum-qemu-100-2025_12_04-15_37_44.vma.zst Notes: Date: 2025-12-04 15:37:44 Format: vma.zst Size: 1.80 GB

Hardware Cloud-Init Options Task History Monitor Backup Replication Snapshots Firewall Permissions

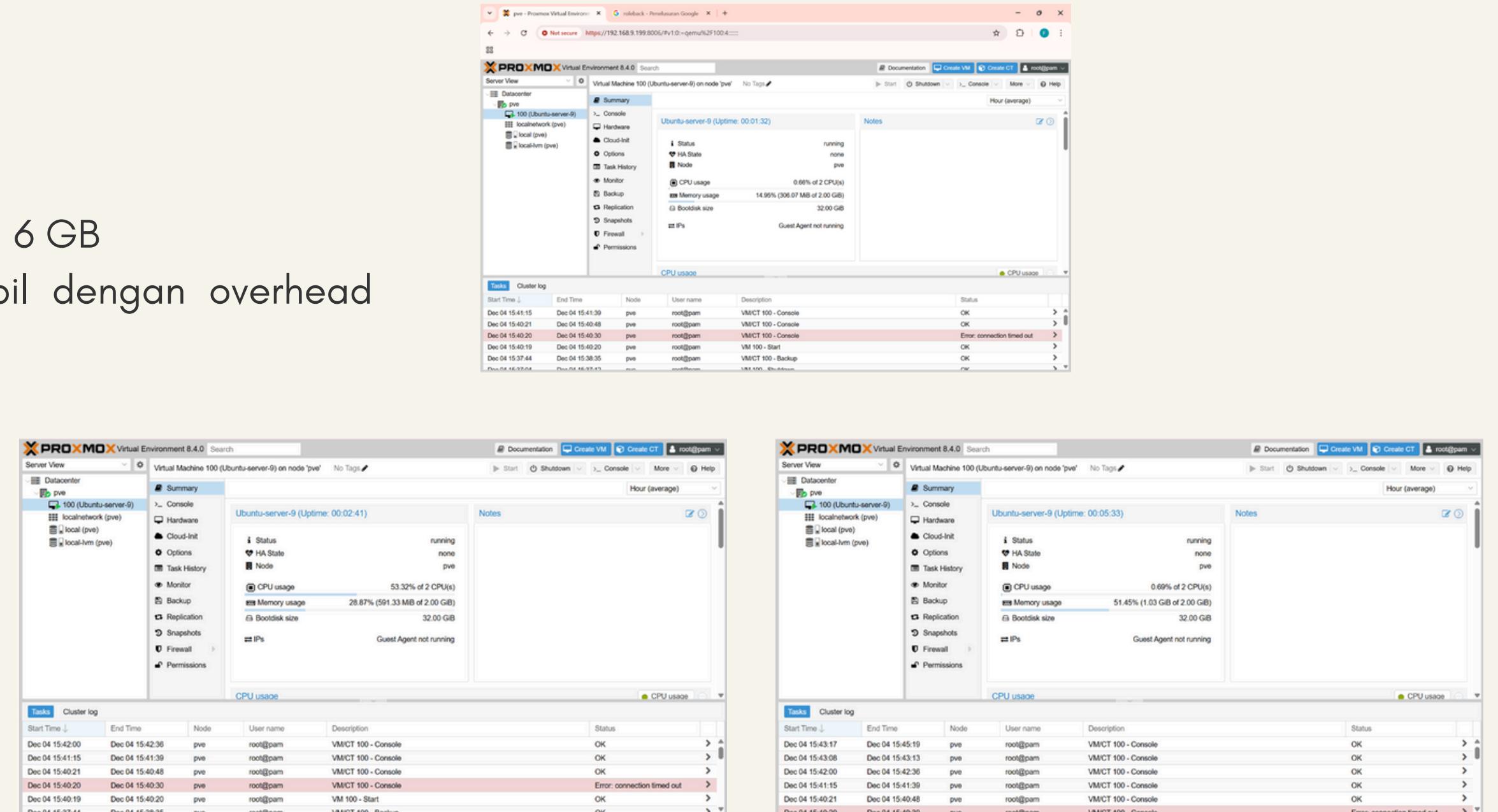
Analisis Performa

Hasil Pengujian:

- CPU idle: 2-4%
- CPU under load: ~40%
- RAM usage: ~3.5 GB dari 6 GB

Kesimpulan: Performa stabil dengan overhead yang wajar.

```
kelompok9@kelompok9:~$ sudo apt upgrade
[sudo] password for kelompok9:
Reading package lists...
Building dependency tree...
Reading state information... Done
Calculating upgrade... Done
The following packages have been kept back:
  libglib2.0-data libgudev1 libudev1 systemd systemd-timesyncd udev
The following packages will be upgraded:
  apt-cloud-init cryptsetup-distro-info-data dmevent dmsetups gir1.2-packagekitglib-1.0 intramfs-tools
  intramfs-tools-bin intramfs-tools-core libapt-pkg6.0 libcryptsetup12 libdevmapper-event1.02.1 libglib2.0-0 libglib2.0-bin
  libglib2.0-data libglide2.5-0 libglom-common liblvm2cm2.03 libopeniscsi2 libpackagekit-glib2-18 libseccomp2 linux-base lvm2 needrestart open-iscsi
  open-iscsi-pids polkit python3-update-manager snappy system-huge-ubuntu-server-minimal xfsprogs
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
Need to get 41.4 MB of archives.
After this operation, 16.7 MB of additional disk space will be used.
Do you want to continue? [Y/N] Y
Get:1 http://id.archive.ubuntu.com/ubuntu jammy-updates/main amd64 libapt-pkg6.0 amd64 2.4.14 [912 kB]
Get:2 http://id.archive.ubuntu.com/ubuntu jammy-updates/main amd64 libseccomp2 amd64 2.5.3-3ubuntu0.22.04.1 [47.4 kB]
Get:3 http://id.archive.ubuntu.com/ubuntu jammy-updates/main amd64 apt-amd64 2.4.14 [1363 kB]
Get:4 http://id.archive.ubuntu.com/ubuntu jammy-updates/main amd64 libdevmapper-event1.02.1 amd64 2:1.02.175-2.1ubuntu5 [139 kB]
Get:5 http://id.archive.ubuntu.com/ubuntu jammy-updates/main amd64 libdevmapper-event1.02.1 amd64 2:1.02.175-2.1ubuntu5 [12.7 kB]
Get:6 http://id.archive.ubuntu.com/ubuntu jammy-updates/main amd64 liblvm2cm2.03 amd64 2.03.11-2.1ubuntu5 [181 kB]
Get:7 http://id.archive.ubuntu.com/ubuntu jammy-updates/main amd64 liblvm2cm2.03 amd64 2.03.11-2.1ubuntu5 [175 kB]
Get:8 http://id.archive.ubuntu.com/ubuntu jammy-updates/main amd64 dmevent1 amd64 2:1.02.175-2.1ubuntu5 [38.2 kB]
Get:9 http://id.archive.ubuntu.com/ubuntu jammy-updates/main amd64 lvm2 amd64 2.03.11-2.1ubuntu5 [1154 kB]
lvm2 8635 B/1154 kB [1]
```





Kesimpulan

Implementasi nested virtualization dengan Mikrotik, VirtualBox, Proxmox VE, dan Ubuntu Server berhasil dilakukan dengan hasil yang memuaskan. Seluruh lapisan arsitektur terintegrasi dengan baik, fitur snapshot dan backup berfungsi normal, serta performa sistem stabil meskipun berjalan pada hardware terbatas. Lingkungan lab virtual yang terbentuk telah siap digunakan untuk pembelajaran, pengujian, dan pengembangan lebih lanjut di bidang virtualisasi dan jaringan.

THANK YOU

