

What is a Hypervisor?

A hypervisor, also known as a virtual machine monitor (VMM), is a piece of software, firmware, or hardware that creates and runs virtual machines (VMs). It allows multiple operating systems to share a single hardware host. Each operating system appears to have the host's processor, memory, and other resources all to itself, but in reality, the hypervisor is controlling the host processor and resources, allocating what is needed to each operating system and ensuring that the virtual machines do not disrupt each other.

Oracle Virtual box - Hypervisor

Oracle VM VirtualBox is a free and open-source hypervisor for x86 virtualization, developed by Oracle Corporation. VirtualBox allows users to run multiple operating systems simultaneously on a single physical machine. It is a type 2 hypervisor, meaning it runs on top of an existing operating system, such as Windows, macOS, Linux, or Solaris, rather than directly on the hardware.

Features

1. Cross-Platform Support:

- Runs on Windows, macOS, Linux, and Solaris hosts.
- Supports a wide range of guest operating systems, including Windows, Linux, macOS, and others.

2. High Performance:

- Optimized to deliver high performance for both host and guest systems.
- Supports multi-threading and multiple virtual CPUs.

3. Snapshots:

- Allows users to save the state of a virtual machine at any point in time.
- Users can revert to a previous state, useful for testing and development.

4. Seamless Mode:

- Integrates guest windows with the host's desktop environment, making applications from the virtual machine appear as if they are running natively on the host.

5. Shared Folders:

- Enables easy sharing of files between the host and guest operating systems.

6. Virtual USB Controllers:

- Supports USB 1.1, 2.0, and 3.0 devices, allowing for the connection of peripheral devices to the virtual machine.

7. Virtual Networking:

- Offers various networking modes like NAT, Bridged, Internal, Host-only, and more.
- Supports virtual network adapters and can simulate complex network topologies.

8. **Extensible:**

- Supports third-party plugins and extensions, enhancing functionality through the VirtualBox Extension Pack.

Benefits

1. **Cost-Effective:**

- Free to use under the GNU General Public License (GPL).
- Reduces hardware costs by allowing multiple virtual machines to run on a single physical machine.

2. **Isolation:**

- Provides an isolated environment for applications, reducing the risk of system crashes and security breaches.

3. **Versatility:**

- Supports a wide range of operating systems and applications, making it suitable for development, testing, and deployment.

4. **Scalability:**

- Easily scalable to match the growing needs of users, from individual developers to enterprise environments.

5. **Convenience:**

- Simplifies software testing and development by allowing users to quickly deploy and test multiple operating systems and applications.

Challenges

1. **Performance Overhead:**

- Running multiple virtual machines can lead to performance degradation, especially on systems with limited resources.

2. **Complexity:**

- Initial setup and configuration can be complex for new users.
- Advanced features may require a deeper understanding of virtualization concepts.

3. **Resource Intensive:**

- Consumes significant amounts of CPU, memory, and disk space, which may affect the host system's performance.

4. **Hardware Compatibility:**

- Certain features, like nested virtualization, may require specific hardware support (e.g., VT-x or AMD-V).

5. **Security:**

- While virtual machines are isolated, vulnerabilities in the virtualization software itself could potentially be exploited.

Installation Procedure

For Windows:

1. Download VirtualBox:

- Visit the Oracle VirtualBox download page.
- Download the Windows installer.

2. Run the Installer:

- Double-click the downloaded installer file.
- Follow the installation wizard's prompts, choosing default settings unless specific changes are needed.

3. Installation Options:

- Choose the installation location.
- Select components to install (e.g., USB support, networking).

4. Network Interfaces Warning:

- You may see a warning about resetting network interfaces; confirm to proceed.

5. Finish Installation:

- Click "Finish" once the installation is complete.
- Launch VirtualBox from the start menu or desktop shortcut.

Step-by-Step Guide to Install Linux OS in VirtualBox

1. Download the Linux ISO

- Visit the official website of the Linux distribution you want to install (e.g., Ubuntu, Fedora, Debian).
- Download the ISO file of the desired Linux distribution.

2. Create a New Virtual Machine

- Open VirtualBox.
- Click on "New" to create a new virtual machine.
- **Name and Operating System:**
 - Enter a name for your virtual machine.
 - Choose "Linux" as the type.
 - Select the appropriate version of the Linux distribution you downloaded (e.g., Ubuntu (64-bit)).
- **Memory Size:**
 - Allocate memory (RAM) for the virtual machine. A minimum of 2 GB (2048 MB) is recommended, but more can be allocated depending on your system's resources.
- **Hard Disk:**

- Select "Create a virtual hard disk now" and click "Create".

3. Create a Virtual Hard Disk

- **Hard Disk File Type:**
 - Choose "VDI (VirtualBox Disk Image)" and click "Next".
- **Storage on Physical Hard Disk:**
 - Choose either "Dynamically allocated" or "Fixed size". Dynamically allocated will grow in size as needed up to a maximum limit.
- **File Location and Size:**
 - Set the size of the virtual hard disk. A minimum of 20 GB is recommended.
 - Click "Create".

4. Configure the Virtual Machine

- Select your new virtual machine and click on "Settings".
- **System:**
 - Go to the "System" section and ensure that "Enable EFI (special OSes only)" is unchecked (unless your Linux distribution requires EFI).
- **Storage:**
 - Go to the "Storage" section.
 - Under "Controller: IDE", click on the empty disk icon.
 - Click on the disk icon next to "Optical Drive" and select "Choose a disk file".
 - Navigate to and select the downloaded Linux ISO file.
- **Network:**
 - Ensure that the network adapter is set to "NAT" (default setting), which allows the virtual machine to access the internet through your host's network connection.

5. Start the Virtual Machine

- Click "Start" to boot the virtual machine.
- The virtual machine will boot from the ISO file, starting the Linux installation process.

6. Install the Linux OS

- Follow the on-screen instructions to install the Linux OS.
 - **Language Selection:** Choose your preferred language and click "Continue".
 - **Installation Type:** Select "Erase disk and install [Linux distribution]" (this affects only the virtual disk).
 - **Disk Partitioning:** Follow the default settings unless you have specific requirements.
 - **User Details:** Enter your name, computer name, username, and password.
 - **Installation:** Click "Install Now" and confirm any changes.
- The installation process will copy files and configure the system. This may take several minutes.

7. Complete Installation and Restart

- Once the installation is complete, you will be prompted to restart the virtual machine.
- Click "Restart Now" and remove the installation media when prompted (go to "Devices" > "Optical Drives" > "Remove disk from virtual drive").

8. Log in to Your New Linux VM

- After the restart, the virtual machine will boot into the newly installed Linux OS.
- Log in with the username and password you created during the installation process.

Xen - Hypervisor

The Xen Hypervisor, commonly referred to simply as Xen, is an open-source hypervisor developed by the Xen Project, which is part of the Linux Foundation. It is a Type 1 hypervisor, meaning it runs directly on the host's hardware to control the hardware and manage guest operating systems, without needing an underlying operating system.

Xen is commonly **associated with paravirtualization**, although it also supports full virtualization. Xen is a Type 1 hypervisor, and while **many Type 1 hypervisors are associated with full virtualization**, Xen's support for paravirtualization is a notable feature.

Features

1. Type 1 Hypervisor:

- Xen is a Type 1 hypervisor, which runs directly on the host's hardware to control the hardware and manage guest operating systems.

2. Paravirtualization and Hardware Virtualization:

- Supports paravirtualization (PV) for enhanced performance and hardware virtualization (HVM) for running unmodified guest operating systems.

3. Scalability:

- Designed for scalability, supporting large numbers of VMs on powerful hosts.

4. Security:

- Uses a small trusted computing base (TCB) and provides strong isolation between VMs, making it a secure option for virtualization.

5. Live Migration:

- Supports live migration, allowing VMs to be moved between hosts without downtime.

6. Resource Management:

- Efficient resource allocation and management features, including CPU pinning, memory ballooning, and network isolation.

7. High Availability and Disaster Recovery:

- Integrates with high availability (HA) and disaster recovery (DR) tools to ensure continuous service and quick recovery from failures.

Benefits

1. Performance:

- Offers near-native performance for VMs, especially with paravirtualization.

2. Flexibility:

- Supports a wide range of operating systems and is highly configurable to meet specific needs.

3. Open Source:

- Xen is an open-source project with a strong community and extensive documentation, reducing costs and providing transparency.

4. Isolation:

- Strong isolation between VMs enhances security, making it suitable for multi-tenant environments.

5. Enterprise-Grade:

- Trusted by many enterprises for cloud computing and data center virtualization due to its robustness and reliability.

Challenges

1. Complexity:

- Installation and configuration can be complex, requiring knowledge of both the hypervisor and the operating system.

2. Hardware Compatibility:

- Requires compatible hardware with virtualization extensions (Intel VT-x or AMD-V).

3. Management Tools:

- While there are management tools available, they may not be as user-friendly as those provided by other hypervisors like VMware.

4. Performance Overhead:

- Although minimal, there can still be some performance overhead compared to running directly on physical hardware.

5. Learning Curve:

- Steeper learning curve for those new to virtualization or coming from different hypervisor platforms.

Installation Procedure of Xen on Ubuntu

Prerequisites

1. Ensure Virtualization Support:

- Verify that your CPU supports virtualization (Intel VT-x or AMD-V) and that it is enabled in the BIOS.

2. Update Ubuntu:

- Ensure your system is up to date.

```
sudo apt update
```

```
sudo apt upgrade -y
```

Step-by-Step Installation

1. Install Xen and Related Packages:

- Install Xen hypervisor and related tools.

```
sudo apt install xen-hypervisor-amd64 xen-tools -y
```

2. Configure GRUB:

- Ensure GRUB is configured to boot with Xen.

```
sudo nano /etc/default/grub
```

- Edit the line GRUB_CMDLINE_LINUX_DEFAULT to:

```
GRUB_CMDLINE_LINUX_DEFAULT="quiet splash iommu=soft"
```

- Update GRUB to apply changes:

```
sudo update-grub
```

3. Reboot the System:

- Reboot your system to load the Xen hypervisor.

```
sudo reboot
```

4. Verify Xen Installation:

- After reboot, verify that Xen is running by checking the Xen info:

```
sudo xl info
```

5. Create and Manage VMs:

- Use Xen tools to create and manage virtual machines. For example, creating a new VM can be done using xen-create-image:

```
sudo xen-create-image --hostname=MyVM --size=10Gb --swap=1Gb --ip=192.168.1.100 --memory=512Mb --arch=amd64 --dist=ubuntu
```

6. Configure Network for VMs:

- Configure networking for your VMs by editing the network configuration files or using Xen's networking scripts.

7. Start a VM:

- Start the newly created VM:

```
sudo xl create /etc/xen/MyVM.cfg
```