Bahir Dar University

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Individual Assignment

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Assigned Operating System: BeOS

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Introduction

These days, virtual machines like VMware Workstation and VirtualBox make it easy to explore different operating systems without needing extra hardware. For this project, I'll be working with **BeOS**, an older operating system that was originally designed for multimedia applications and high performance.

BeOS is an operating system for personal computers first developed by BE inc. in 1991. It was first written to run on be box hardware.

BeOS was built for digital media work and was written to take advantage of modern hardware facilities such as symmetric multiprocessing by utilizing modular I/O bandwidth, pervasive multithreading, preemptive multitasking and a 64-bit journaling file system known as BFS.

The BeOS GUI was developed on the principles of clarity and a clean, uncluttered design. BeOS used Unicode as the default encoding in the GUI, though support for input methods such as bidirectional text input was never realized.

BeOS was positioned as a multimedia platform that could be used by a substantial population of desktop users and a competitor to Classic Mac OS and Microsoft Windows. It was ultimately unable to achieve a significant market share, however, and proved commercially unviable for Be Inc. The company was acquired by Palm Inc. and today BeOS is mainly used and developed by a small population of enthusiasts.

HISTORY

Initially designed to run on AT&T Hobbit-based hardware, BeOS was later modified to run on **PowerPC-based processors**: first Be's own systems, later Apple Inc.**'s** PowerPC Reference Platform and Common Hardware Reference Platform, with the hope that Apple would purchase or license BeOS as a replacement for its aging Classic Mac OS. Apple CEO Gil Amelio started negotiations to buy Be Inc., but negotiations stalled when Be CEO Jean-Louis Gassée wanted $300 million; Apple was unwilling to offer any more than $125 million. Apple's board of directors decided NeXTSTEP was a better choice and purchased next in 1996 for $429 million, bringing back Apple co-founder Steve Jobs.

BeOS 5.0 Personal Edition

This version of BeOS is the Personal Edition, which can be downloaded freely from the Internet and installed under Windows and vitual machine like vmware.

One of the most noted features of BeOS is its use of tabs instead of typical title bars. This perhaps saves a little bit of screen space and definitely gives the windowing system a unique appearance.

Clicking on the BeOS logo on the Deskbar brings up a menu with programs you can run. The Deskbar can also be dragged to other corners of the screen or to the upper or lower of the screen to give it a "Windows task bar" appearance.

Unlike other operating systems of the time, BeOS supported multi-threaded applications and included support for multiprocessor machines from the start. After an upgrade, it also included a multi-threaded,

BeOS also shipped with a web browser and had UNIX-like elements, including support for a Bash command-line interface, despite the fact that it wasn't Unix-based. It also supported virtual desktops for productivity, a feature that still isn't implemented at BeOS-levels in most modern operating systems.

Objectives

The main goal of this project is to install and explore the BeOS operating system using virtualization tools like VMware Workstation or Oracle VM VirtualBox. Since BeOS is a discontinued OS, this will help me learn how older systems worked and how to set them up using modern virtualization tools.

- More specifically, the objectives are:
- To successfully install BeOS in a virtual environment.
- To understand the unique features of BeOS, especially how it handles multimedia and multitasking.
- To gain hands-on experience with virtual machines and operating system configuration.
- To document the process clearly, including any issues faced and how they were solved

BeOS was very attuned to be a good multimedia environment where POSIX apps would run well
BeOS prided itself to be a “multimedia” operating system, optimized for better CPU scheduling, capable of accommodating more than one CPU in an age when personal computers with multiple CPUs were unheard of. It was also designed to handle real time audio mixing, at the expense of extra CPU power and RAM usage. It had everything Windows 98 had and more, except one fundamental thing: market share. And with market share come developers. And with developers come applications.

Requirements

Hardware Requirements

- A BeOS Ready Intel Architecture System. See below for how to determine if your system is compatible with the BeOS for Intel.
- An IDE or SCSI hard disk or hard disk partition with 150 megabytes of space, more highly recommended.

- The BeOS includes a special edition of PowerQuest's PartitionMagic tool to make partitioning your hard drive to make room for the BeOS as quickly and easily as possible.
- Keyboard and mouse compatible with your hardware.

  Serial or PS/2 mice and standard PC-style and PS/2 keyboards are supported. A two (or more) button mouse is highly recommended (serial mice with three buttons will not work; use a one- or two-button serial mouse, or a PS/2-style mouse). An extended keyboard is record

- A modern multi-core **Processor** CPU (Intel or AMD) with virtualization support (VT-x or AMD-V).
- A minimum of **Storage**10 GB of free disk space to install virtualization tools and store the virtual machine files.

Software Requirements

1. Virtual Machine Software

This is the main program that lets me cre ate a "virtual computer" inside my real computer. Like VirtualBox or VMware

2. BeOS Operating System Image (ISO file)

This is basically the "installer" for BeOS—just like how we install Windows using a setup file or disc image. Since BeOS is no longer officially supported, I'll be using a downloaded copy of **BeOS R5**, which was the last version made by Be Inc.

3. Host Operating System (My Main OS)

This is the operating system that's already on my computer—the one I use every day. It doesn't really matter which one, as long as it supports the virtual machine software I'm using. Like Windows (like Windows 10 or 11), Linux (like Ubuntu)

How the installing process of beos starting from vmware workstation

Download Required Files

- **BeOS 5 PE Max Edition V4b1 ISO**:
  Download from Retrospace.
- **BeOS Boot CD Image**:
  You can obtain the `intel_r5.0.3_boot_cd.img` from BeOS Max Files.

Create a New Virtual Machine in VMware

- **Open VMware Workstation** and click on **"Create a New Virtual Machine"**.
- **Choose "Custom (advanced)"** and click **Next**.

- **Hardware Compatibility**: Select the default or appropriate version and click **Next**.
- **Guest Operating System Installation**: Choose **"I will install the operating system later"** and click **Next**.
- **Select Guest Operating System**:

✓ **Guest OS**: Choose **"Other"**.
✓ **Version**: Select **"Other"**.Click **Next**.

- **Name the Virtual Machine**: Enter a name like "BeOS 5 PE Max" and choose a location. Click **Next**.
- **Processor Configuration**:

✓ **Number of processors**: 1
✓ **Number of cores per processor**: 1

Click **Next**.

- **Memory for the Virtual Machine**: Set to **256 MB**. Click **Next**.
- **Network Type**: Select **NAT**. Click **Next**.
- **I/O Controller Types**: Choose **LSI Logic**. Click **Next**.
- **Disk Type**: Select **IDE**. Click **Next**.
- **Select a Disk**:

✓ Choose **"Create a new virtual disk"**. Click **Next**.
✓ **Maximum disk size**: 8 GB
✓ **Split virtual disk into multiple files**: CheckedClick **Next**.

- **Specify Disk File**: Leave the default or rename as desired. Click **Finish**.

Configure CD/DVD Drives

1) **Add Two CD/DVD Drives**:

i. In the VM settings, click **"Add"**, select **"CD/DVD Drive"**, and click **Next**.
ii. Repeat to add a second CD/DVD drive.

A ***Configure the First CD/DVD Drive****:*

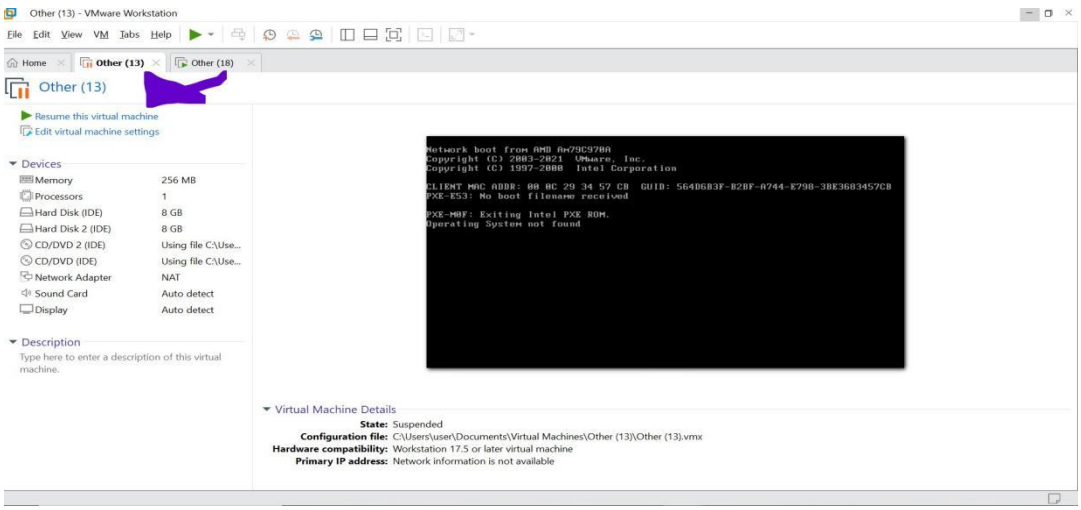
✓ Select **"Use ISO image file"**.
✓ Browse and select the `intel_r5.0.3_boot_cd.img` file.

B ***Configure the Second CD/DVD Drive****:*

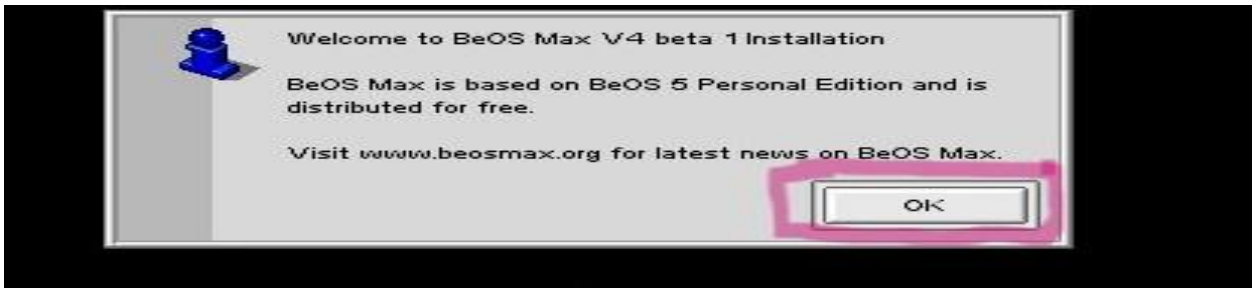
✓ Select **"Use ISO image file"**.
✓ Browse and select the `BeOS5PEMaxEditionV4b1.iso` file.

Start the Virtual Machine and Begin Installation

I. Power on the Virtual Machine.

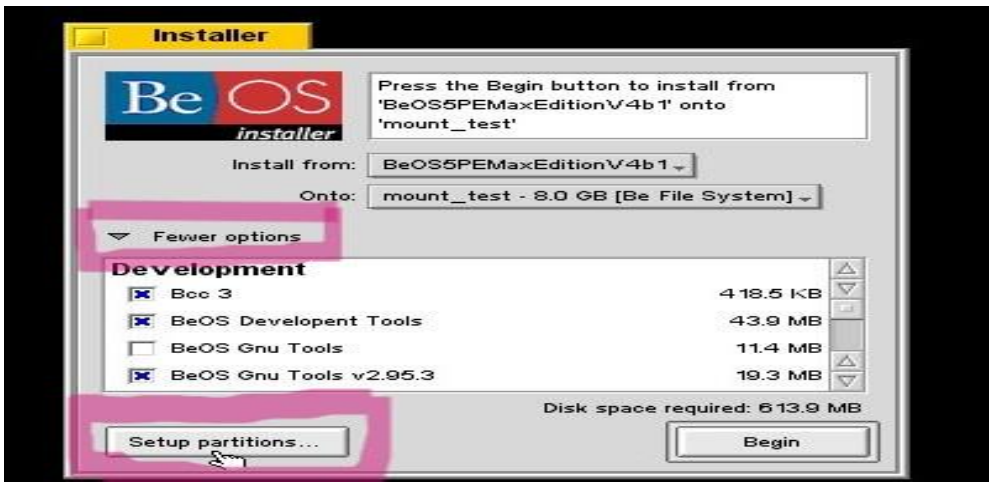


II. When prompted, select **"Install"** to proceed to the Installer screen.

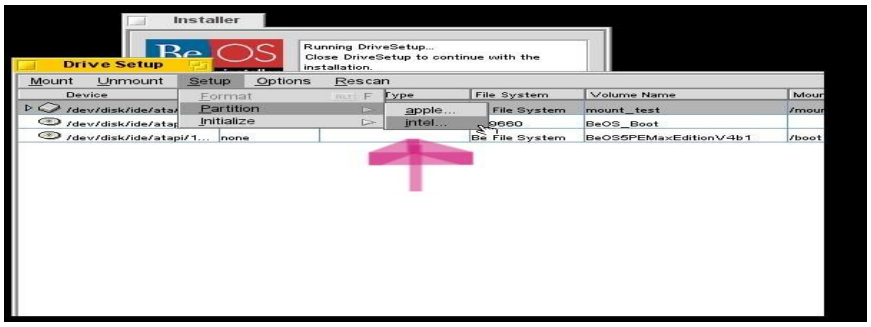


III. **Partitioning the Disk**:

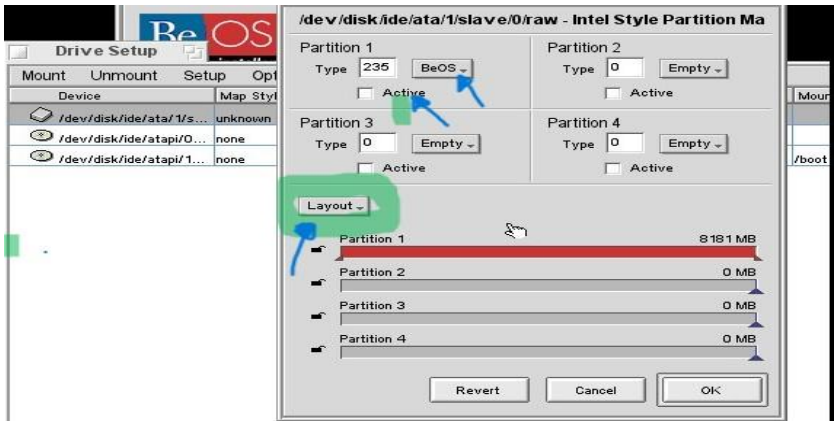
✓ Click on **"More options"** and select **"Setup partitions"**.



I. Right-click on the target partition (usually the first one) and navigate to **"Setup" > "Partition" > "Intel"**.

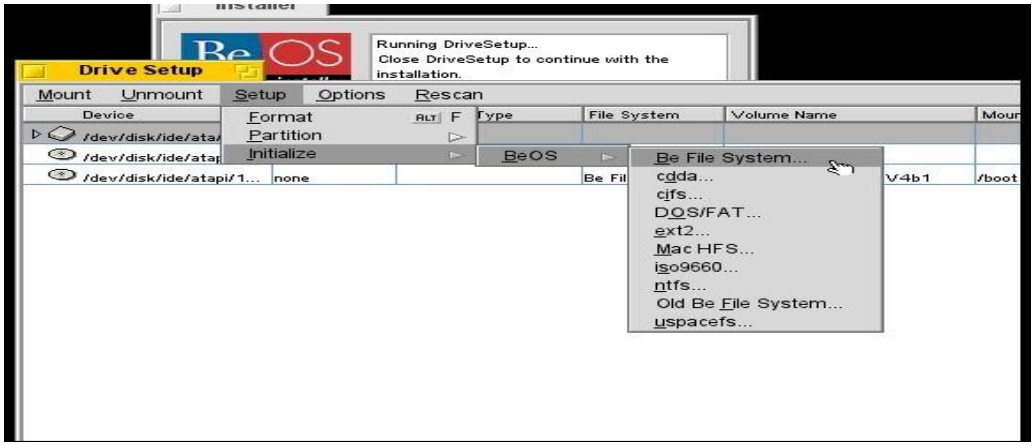


II. Click on **"Empty"** in the "Partition 1" square, select **"BeOS"**, mark as **"Active"**, click **"Layout"**, choose **"100% partition"**, then click **"OK"** and **"Proceed"**.

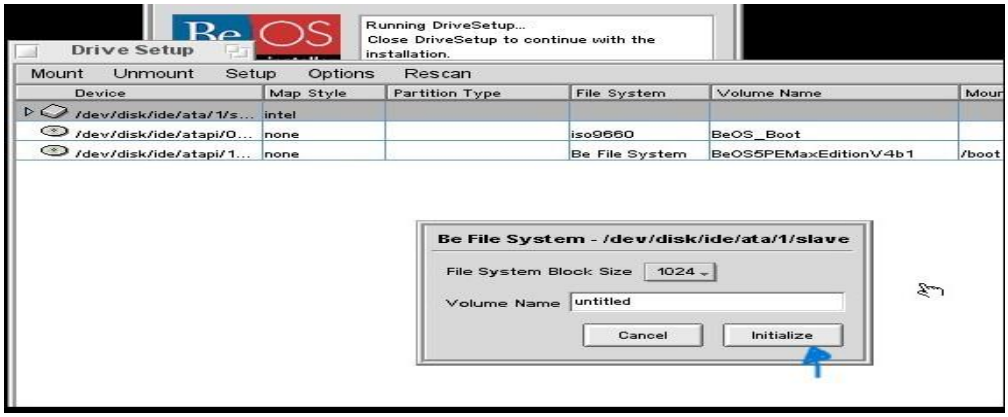


III. **Initializing the Partition**:

Right-click on the target partition again, go to **"Setup" > "Initialize" > "BeOS" > "Be File System"**.



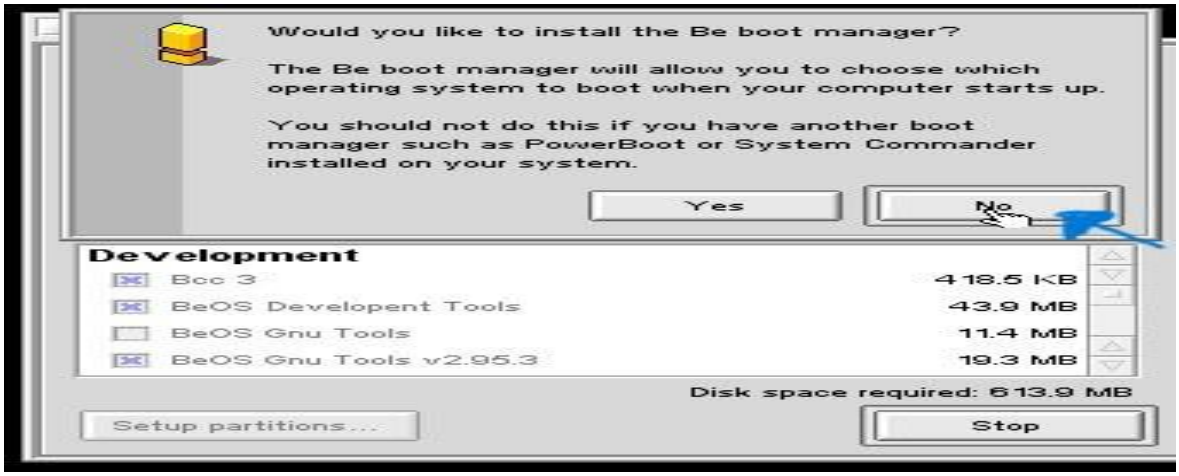
IV. Enter a volume name, click **"Initialize"**, then **"Proceed"**, and finally **"Mount"**.



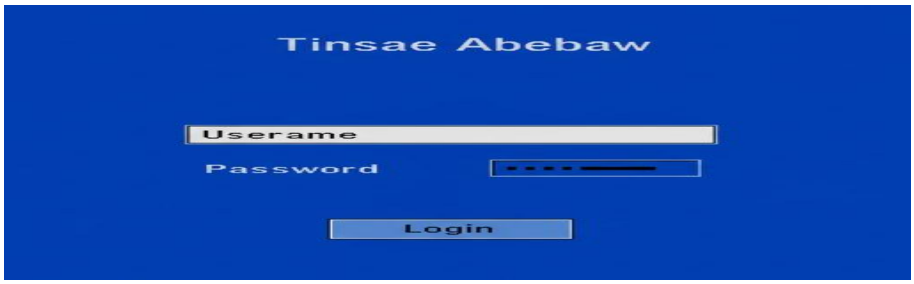
V. **Installing BeOS**:

- In the Installer, select the components you wish to install.
- Click **"Begin"** to start the installation.

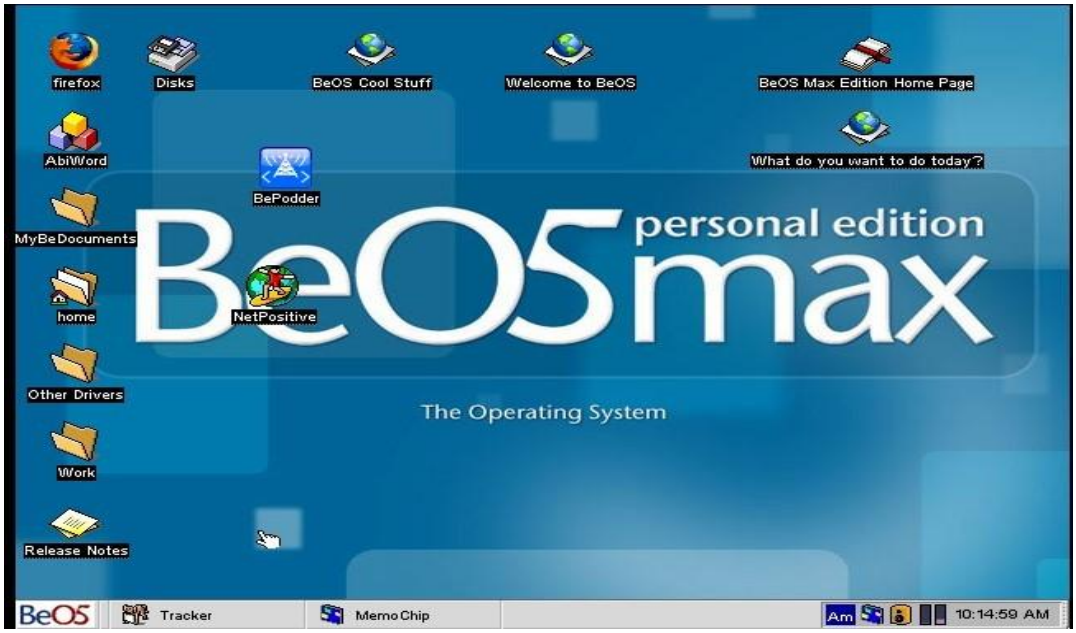
I. Once finished, when prompted to install the Be Boot Manager, choose **"Dismiss"** and click **"Quit"**.



Creating an account:



And In the last newly installed BeOS 5 PE Max Edition!



Issues (Problems Faced)

While trying to install BeOS in a virtual machine, I ran into a few issues. Since BeOS is quite old, it's not always fully compatible with modern virtualization software. Here are some of the problems I faced:

1) The BeOS ISO or image file did not boot in VMware

2)Couldn't select the .img file when browsing in VMware.

3)During partitioning, the "Partition 1" option was not clickable

4) No keyboard input in BeOS when running in VMware.

5) After installation, BeOS shows “No bootable disk found.”

Solutions:

I. **Solution for Boot Error:**

- Use VirtualBox or VMware and set OS type to "Other".
- Use the correct BeOS boot image (`intel_r5.0.3_boot_cd.img`) as the first CD.

II. **Solution for `.img` file not showing:**

- In VMware “Browse” dialog, change the file type dropdown to “All files (*)”.
- Then select the `.img` file and proceed.

III. **Solution for partition issue:**

- Go to “More Options” → “Setup Partitions”.
- Right-click → Setup → Partition → Intel → Click “Empty” → Select “BeOS” → Mark Active → Layout = 100%.

IV. **Solution for keyboard issue:**

- Try changing VMware version or use VirtualBox.
- Enable “PS/2 Mouse and Keyboard” in VM settings.

V. **Solution for boot issue after install:**

- Make sure the virtual disk is set as primary boot
- Don't forget to install BeOS Boot Manager if required.

BeOS was designed with its own custom filesystem called **BFS** (Be File System). It's optimized for speed and flexibility, especially for multimedia tasks. Here's how BeOS handles different common filesystems:

- ✓ ✅ **BFS (Be File System)** – *Fully supported*. This is BeOS's native filesystem.
- ✓ ✅ **FAT16 / FAT32** – *Partially supported*. BeOS can read and write to FAT partitions. Helpful for sharing files with Windows.
- ✓
- ✓ ✅ **ISO 9660** – *Supported*. For reading files from CDs and DVDs.

❌ **NTFS (Windows)** – *Not supported*. BeOS cannot read or write to NTFS drives.

❌ **exFAT (Modern Windows/USB)** – *Not supported*. Not available in BeOS.

❌ **ext4 / ext3 / ext2 (Linux)** – *Not supported by default*.

❌ **Btrfs, ZFS, HFS+, APFS** – *Not supported*. These are modern filesystems used in Linux or macOS and are not compatible with BeOS.

Why doesn't BeOS support modern filesystems like NTFS or ext4?
BeOS was developed in the late 1990s and wasn't updated to include modern filesystems. It was mainly focused on its own BFS and some basic interoperability (like FAT32).

Advantages of BeOS

- ❖ **Super Fast and Smooth**
  BeOS was designed from the ground up to be fast. Everything from opening apps to handling multimedia felt quicker and more responsive than other operating systems at the time. It was known for its speed—even on older hardware.
- ❖ **Great for Multimedia**
  BeOS was way ahead of its time in handling audio and video. It was made to work well with sound editing, video playback, and graphics-heavy tasks, making it a favorite for artists, musicians, and media developers back then.

- ❖ **True Multitasking**
  BeOS handled multiple tasks really well. You could run many programs at once, and the system stayed stable. This is thanks to its **preemptive multitasking** and **multi-threaded** design.

- **Clean and Lightweight Interface**
  The user interface was simple, minimal, and not bloated. It focused on being efficient and getting things done—no unnecessary features or clutter.
- **Ahead of Its Time**
  Concepts like 64-bit journaling file systems (BFS), support for multiple CPUs, and real-time processing made BeOS feel futuristic when it first came out.

Disadvantages of BeOS

- **Lack of Software Support**
  One of the biggest downsides was that very few applications were developed for BeOS. Most popular software didn't work on it, which made it hard to use for everyday tasks.
- **Limited Hardware Compatibility**
  BeOS didn't support a wide range of hardware—especially newer devices. Things like Wi-Fi cards, printers, and sound cards often didn't work without a lot of manual tweaking.
- **No Longer Maintained**
  BeOS is officially discontinued. That means no updates, no security patches, and no official help if something breaks.
- **Not Suitable for Modern Use**
  Since it's outdated, it doesn't support modern web browsers, drivers, or tools. So while it's interesting to explore, it's not practical for daily use today.
- **Hard to Set Up**
  Installing BeOS on modern systems—especially in virtual machines—takes effort. You'll probably run into issues with booting, input devices, or display settings.

Conclusion

- In conclusion, installing BeOS in a virtual environment was both challenging and rewarding. While the OS itself was ahead of its time in terms of performance, it's clear that it hasn't aged well for modern use. The process of getting BeOS to run smoothly in VirtualBox was full of problems, but it also taught me a lot about working with virtual machines and troubleshooting old systems.

Even though BeOS is no longer a practical option for daily use, this experience gave me valuable insight into the development of operating systems and the way technology evolves over time.

Future Outlook or Recommendation

Looking ahead, I wouldn't recommend using BeOS for any serious work, as it lacks the software support and hardware compatibility modern systems offer. However, for anyone interested in retro computing or operating system history, setting up BeOS in

a virtual machine is a fun project that can provide a deeper understanding of older technology.

- for anyone who wants to explore it, I highly recommend:

- Using community-enhanced versions like **BeOS Max Edition**

- Researching common problems and solutions before installation

- Choosing more modern OSes (e.g., Haiku OS, a BeOS-inspired project) for deeper exploration of its legacy

2) what, why, and how virtualization in modern operating system.

What is Virtualization?

Virtualization is a technology that enables the creation of virtual environments from a single physical machine, allowing for more efficient use of resources by distributing them across computing environments. and also,Virtualization is technology that you can use to create virtual representations of servers, storage, networks, and other physical machines. Virtual software mimics the functions of physical hardware to run multiple virtual machines simultaneously on a single physical machine. Businesses use virtualization to use their hardware resources efficiently and get greater returns from their investment. It also powers cloud computing services that help organizations manage infrastructure more efficiently.

Used for decades, virtualization is a powerful technology within IT infrastructure that can be used to increase efficiency, retain flexibility, and improve scalability. Because multiple operating systems can share the same physical hardware, virtualization can improve resource use, reduce costs associated with physical maintenance, and boost security through isolated systems.

Whether you're a virtualization administrator running test environments on your workstation or a large organization running a multitude of virtual machines (VMs) across your hybrid cloud platform, virtualization plays a key role in modern IT infrastructure and workloads

How Virtualization Works in Modern Operating Systems

Virtualization is a technology that allows one physical computer (called the **host**) to run multiple separate **virtual computers** (called **virtual machines** or **VMs**) at the same time. Each virtual machine can run its own operating system, as if it were a real, separate physical computer.

1. The Role of a Hypervisor

At the heart of virtualization is something called a **hypervisor**. It's a special piece of software that sits between the hardware and the virtual machines. The hypervisor's job is to:

- Share the real hardware (CPU, memory, disk, etc.) with the virtual machines
- Keep each virtual machine isolated and secure from the others
- Simulate virtual hardware for the guest operating systems

There are **two main types** of hypervisors:

- ✓ **Type 1 (bare-metal)**: Runs directly on the hardware (e.g., VMware ESXi, Microsoft Hyper-V)
- ✓ **Type 2 (hosted)**: Runs on top of a host operating system (e.g., Oracle VirtualBox, VMware Workstation)

2. How It Works Step-by-Step

Here's how virtualization usually works in a modern OS:

1) **Install a hypervisor** (like VirtualBox or VMware) on your main operating system.
2) **Create a virtual machine** by telling the hypervisor how much RAM, CPU, and storage you want it to use.
3) **Install an operating system** inside that virtual machine just like you would on a real computer (e.g., Windows, Linux, BeOS).
4) The hypervisor handles everything in the background—translating input/output, managing memory, and simulating the computer's hardware.
5) The guest operating system inside the VM *thinks* it's running on a real computer, but it's actually running on virtual hardware created by the hypervisor.

3. Why It' s Useful

- **Testing**: You can test new software or operating systems without affecting your main system.
- **Security**: Isolates risky software or files in a safe environment.
- **Efficiency**: Lets you run multiple OSes on one physical machine, saving costs and space.
- **Development**: Software developers can test apps in different operating systems easily.

Why Virtualization Works in Modern Operating Systems

Virtualization works in modern operating systems **because of a combination of advanced hardware features, powerful software (hypervisors), and better system design**. These improvements make it possible to run multiple operating systems on the same physical machine safely, efficiently, and reliably.

Here are the key reasons why it works today:

1. Hardware Support for Virtualization

Modern CPUs from Intel and AMD include built-in features specifically designed to support virtualization:

- **Intel VT-x (Virtualization Technology)**
- **AMD-V (AMD Virtualization)**

These technologies allow the CPU to directly support running multiple virtual machines by:

- Speeding up the translation between virtual and real hardware
- Allowing guest operating systems to run more securely and efficiently
- Reducing the performance overhead that used to exist in older system

Without this hardware support, virtualization would be much slower or even impossible for some systems.

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2. Advanced Hypervisors

Modern operating systems can run powerful **hypervisors**, which are specially designed programs that:

- Manage the virtual machines
- Share resources like CPU, memory, and disk

- Keep each VM isolated and secure

These hypervisors are smart enough to handle complex hardware sharing, making virtualization smooth and stable.