BAHIR DAR INSTITUTE OF TECHNOLOGY

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Operating System and System Programming

Minix OS

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MINIX OS INTRODUCTION

MINIX originally was developed in 1987 by Andrew S. Tanenbaum as a teaching tool for his textbook Operating Systems Design and Implementation. Today, it is a text-oriented operating system with a kernel of less than 6,000 lines of code. MINIX's largest claim to fame is as an example of a microkernel, in which each device driver runs as an isolated user-mode process—a structure that not only increases security but also reliability, because it means a bug in a driver cannot bring down the entire system.In its heyday during the early 1990s, MINIX was popular among hobbyists and developers because of its inexpensive proprietary license. However, by the time it was licensed under a BSD-style license in 2000, MINIX had been overshadowed by other free-licensed operating systems.Today, MINIX is best known as a footnote in GNU/Linux history. It inspired Linus Torvalds to develop Linux, and some of his early work was written on MINIX. Probably too, Torvalds' early decision to support the MINIX filesystem is responsible for the Linux kernel's support of almost every filesystem imaginable.

Later, Torvalds and Tanenbaum had a frank e-mail debate about the relative merits of macrokernels and microkernels. This early history resurfaced in 2004 when Kenneth Brown of the Alexis de Tocqueville Institution prepared a book alleging that Torvalds borrowed code from MINIX—a charge that Tanenbaum, among others, so comprehensively debunked, and the book was never actually published (see Resources).Now at version 3.1.6, MINIX has taken a turn in its development. While versions 1 and 2 focused primarily on the operating system as a learning tool, with version 3, MINIX began targeting low-cost laptops and embedded devices as well. More generally, the project's Web page recommends MINIX for “applications where very high reliability is required” and for projects where the GNU General Public License would be too restrictive.However, these new targets seem more ideal than real. I can find little evidence of MINIX being used in embedded devices or for its high reliability or licensing. Similarly, MINIX still lacks the user-friendliness that would make it a candidate for a project like One Laptop Per Child. As with previous releases, MINIX's greatest value continues to be as an educational aid to give users experience of another UNIX-like system.

Objectives

- Download MINIX 3: Obtain a valid and complete ISO image of the MINIX 3 operating system from the official MINIX website (http://www.minix3.org/).
- Identify System Requirements: identify the hardware and software Requirements MINIX OS needed
- About MINIX OS History
- Select an Installation Method: Choose a suitable installation method (e.g., virtual machine, dual-boot, dedicated installation) based on the assignment requirements and available resources.
- Install MINIX 3: Successfully install the MINIX 3 operating system using the chosen installation method.
- Document the Process: document all steps of the downloading process and documentation about MINIX 3

- Advantage and disadvantage about MINIX OS
- Future outlook and recommendation about MINIX OS

Hardware Requirements for MINIX 3

- **Processor**: At least 500 MHz (can run on slower processors).
- **Memory (RAM)**: Minimum 256 MB (can run with less).
- **Storage**: At least 1 GB for the base system (recommend 2-5 GB for more software and updates).
- **Graphics**: Basic VGA-compatible graphics card (MINIX 3 is command-line based).
- **Input Devices**: Keyboard and mouse for installation.
- **Network Adapter (Optional)**: For network connection.

Software Requirements for MINIX 3

- **Installation Media**:
  - ISO Image from the official website.
  - Bootable USB (at least 1 GB) or DVD.
- **Tools for Creating Bootable Media**:
  - Rufus (Windows) or Etcher (Cross-Platform) for creating bootable USB drives.
- **Virtualization Software**:
  - VirtualBox (free) or VMware Workstation Player (free for personal use).
- **Other Software**:
  - Terminal Emulator (e.g., PuTTY, iTerm2) for remote installation.
  - Text Editor (e.g., vi, nano) for editing files and configurations.

➢ Problem I faced when I install minix3 OS

1. The OS Screen is too small
2. I should login using my name during installation of MINIX 3, But the system is configured to have a single default user account which is **root**.it only accept other username after installation
   - Username: root
   - Password: Usually none initially
3. Error reading or mounting disk

Solution for the problem listed above

1. MINIX doesn't support Guest Additions. Use the default terminal view. You can press Host + F to toggle full screen.
2. log into MINIX 3 using your own username instead of the root user, you'll need to create a new user account after installation.
   Here's how to create a user in MINIX 3 :

- First log in as root
- Use the adduser command

adduser <username>

Replace <username> with the desired username (e.g., adduser hilina). The adduser command will typically prompt you for:

* A password for the new user.
* Full name
* Room number, Work Phone, Home Phone

3. Make sure the virtual hard disk is attached in VM Settings > Storage.Redownload the MINIX ISO from the official site to avoid corruption. Use VHD or VDI format and Dynamically allocated storage.

Minix 3 OS Filesystem support

MINIX 3 has its own filesystem, and does not natively support many of the modern filesystems like NTFS, ext4, Btrfs, ZFS, HFS+, or APFS.

Filesystems Supported by MINIX 3

- **MINIX File System (v1, v2, v3)**: MINIX 3 primarily uses its native MINIX file system, especially MINIX v3, which is simple, robust, and well-suited to the OS's microkernel design. It is specifically designed to be lightweight, making it easy to understand and modify for educational use.
- **FAT12/FAT16** (limited support): Some older or basic FAT formats (like FAT12 or FAT16) may have partial support via user-space tools or bootloaders for compatibility with legacy systems or removable media.

Filesystems Not Supported by MINIX 3 (by default)

-Not supported Filesystem	Why Not Supported?
NTFS	Complex, proprietary, and not open-source-friendly.
FAT32	More complex than FAT12/16; not natively supported.
exFAT	Proprietary and relatively complex; not open source.
ext4	Designed for Linux; very complex and not compatible with MINIX's modular structure.
Btrfs	Very advanced and complex; incompatible with MINIX's simplicity.
ZFS	Extremely resource-intensive and complex.
HFS+ / APFS	Apple proprietary formats; not open and very complex.

Why MINIX 3 Avoids These Filesystems:

1. **Simplicity & Educational Use:** MINIX 3 is built primarily for learning and experimentation. Complex filesystems like ext4 or NTFS are harder to teach and maintain.
2. **Microkernel Design:** File system drivers run in user space, so simplicity and reliability are key. Advanced filesystems increase complexity and risk.
3. **Resource Constraints:** MINIX is optimized for low-resource environments and embedded systems, where simpler filesystems perform better.
4. **Licensing Issues:** Some filesystems like NTFS, exFAT, HFS+, and APFS are proprietary, which limits or prohibits open-source implementation.

Advantage and Disadvantage of the Minix3 OS

Running MINIX 3 in Oracle VM VirtualBox comes with a few advantages and disadvantages. Here's a quick overview of both:

Advantages

1. Lightweight OS: MINIX 3 is very lightweight and runs smoothly in virtual machines with little resources.

2. Educational Use It's ideal for understanding OS ideas like microkernels, system calls, and managing processes.

3. Safe Testing Environment VirtualBox keeps MINIX separate from your main computer, so you can try things without harming your main system.

4. Snapshot Feature You can save the current state in VirtualBox before making changes to MINIX.

5. Cross-Platform: MINIX runs on Windows, Linux, or macOS through VirtualBox.

Disadvantages

1.Limited Hardware Support: MINIX 3 may not work well with all hardware and devices, so you might need to set up networking and display manually.

2. Minimal User Interface: There's no default graphical interface; it mostly uses command-line, which may not suit all users.

3.Performance Limitations: Although MINIX is lightweight, VirtualBox may not offer optimal performance, especially on older machines.

4.Software Compatibility: MINIX has fewer software options compared to Linux or BSD, limiting what you can use with it.

5. Installation Complexity: Setting up MINIX in VirtualBox can be challenging and may involve manual partitioning or configuring the boot loader.

Future Outlook & Recommendations for MINIX 3 Operating System

Future Outlook

1.Niche Use in Embedded Systems: MINIX 3 is aimed at reliability, fault tolerance, and microkernel architecture which gives it a niche use in embedded systems.

2. Educational Tool: It will serve as an excellent educational environment for students and researchers interested in OS internals, namely microkernels, system calls, and process isolation.

3. Limited Mainstream Adoption: Because MINIX 3 isn't built to compete with Linux or Windows for general-purpose use, any chance of it catching on in the broader tech sector is likely pretty limited unless it finds a unique purpose or receives some big sponsorship.

4. Research & Academic Projects: It might keep having slow evolution on system side as part of research in academia It could provide a foundation for experimental features or concepts for the OS.

Recommendation

1. For Students & Educators: Learn OS concepts like microkernel architecture, fault recovery and message passing on MINIX3. It's a great resource for doing coursework or learning on your own.

2. For Developers: Explore MINIX 3 if you are looking into secure, robust systems, or have encountered an embedded device that required high overall reliability.

3.For Experimenters & Hobbyists: Run it in VirtualBox to try out OS-level things, or to learn low-level programming without worrying about your main system.

4.Not recommended for daily use: It doesn't have enough hardware and software support to be practical as a desktop OS or for modern application development.

5.Contribute Project: If you enjoy OS development, MINIX is a simple, well-documented codebase that might be a good point for contributing or creating your own OS variant.

What is Virtualization in Modern Operating Systems?

Virtualization is the creation of a virtual version of an actual piece of technology, such as an operating system (OS), a server, a storage device or a network resource.

Virtualization uses software that simulates hardware functionality to create a virtual system. This practice lets IT organizations run multiple OSes, more than one virtual system and various applications on a single server. The benefits of virtualization include greater efficiency and economies of scale.

OS virtualization uses software that enables a piece of hardware to run multiple operating system images at the same time. The technology got its start on mainframes decades ago to save on expensive processing power.

Why Use Virtualization?

Virtualizing your environment can increase scalability while simultaneously reducing expenses. Check out a few of the many benefits that virtualization can bring to your organization:

1. Slash your IT expenses

Using a non-virtualized environment can be inefficient because when you are not consuming the application on the server, the compute is sitting idle and can't be used for other applications. When you virtualize an environment, that single physical server transforms into many virtual machines. These virtual machines can have different operating systems and run different applications while still all being hosted on the single physical server.

The consolidation of the applications onto virtualized environments is a more cost-effective approach because you'll be able to consume fewer physical customers, helping you spend significantly less money on servers and bring cost savings to your organization.

2. Reduce downtime and enhance resiliency in disaster recovery situations

When a disaster affects a physical server, someone is responsible for replacing or fixing it—this could take hours or even days. With a virtualized environment, it's easy to provision and deploy, allowing you to replicate or clone the virtual machine that's been affected.

The recovery process would take mere minutes—as opposed to the hours it would take to provision and set up a new physical server—significantly enhancing the resiliency of the environment and improving business continuity.

3. Increase efficiency and productivity

With fewer servers, your IT teams will be able to spend less time maintaining the physical hardware and IT infrastructure. You'll be able to install, update and maintain the environment across all the VMs in the virtual environment on the server instead of going through the laborious and tedious process of applying the updates server-by-server. Less time dedicated to maintaining the environment increases your team's efficiency and productivity.

4. Control independence and DevOps

Since the virtualized environment is segmented into virtual machines, your developers can quickly spin up a virtual machine without impacting a production environment. This is ideal for development and testing, as the developer can quickly clone the virtual machine and run a test on the environment.

How virtualization works

Virtualization technology abstracts an application, guest operating system or data storage away from its underlying hardware or software.

Organizations that divide their hard drives into different partitions already engage in virtualization. A partition is the logical division of a hard disk drive that, in effect, creates two separate hard drives.

Server virtualization is a key use of virtualization technology. It uses a software layer called a hypervisor to emulate the underlying hardware. This includes the central processing unit's (CPU's) memory, input/output and network traffic.

Hypervisors take the physical resources and separate them for the virtual environment. They can sit on top of an OS or be directly installed onto the hardware.

Xen hypervisor is an open source software program that manages the low-level interactions that occur between virtual machines (VMs) and physical hardware. It enables the simultaneous creation, execution and management of various VMs in one physical environment. With the help of the hypervisor, the guest OS, which normally interacts with true hardware, does so with a software emulation of that hardware.

Although OSes running on true hardware often outperform those running on virtual systems, most guest OSes and applications don't fully use the underlying hardware. Virtualization removes dependency on a given hardware platform, creating greater flexibility, control and isolation for environments. Plus, virtualization has spread beyond servers to include applications, networks, data management and desktops.

conclusion

Downloading and installing MINIX 3 on Oracle VM VirtualBox gives productive and adaptable way to investigate a lightweight, Unix-like working framework fundamentally utilized for instructive and inquire about purposes. The virtualization prepare guarantees that clients can securely connected with the OS without influencing their essential framework. MINIX 3's microkernel engineering offers profitable bits of

knowledge into OS plan, blame resistance, and secluded framework improvement. By and large, setting up MINIX 3 in VirtualBox may be a clear handle that opens the entryway to hands-on learning and experimentation with an working framework that has impacted major advances, counting the advancement of present day microkernel-based frameworks.

Reference

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