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**Case study on**  
**Building a Computer System**  
**Evaluating a Simple Computer Design**  
**Virtual Machine**

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# **Chapter 1: Building a Computer System**

## **Introduction**

In today's technology driven world, having a high-performance computer system is essential for various demanding tasks such as gaming, content creation, software development, and more. While pre-built computers offer convenience, they often come with limitations in customization, performance, and cost-effectiveness. Building a custom computer system allows for tailored performance to meet specific needs, providing an opportunity to select each component based on individual preferences and requirements.

This case study explores the process of building a high-performance, cost-effective computer system designed for high-end tasks like gaming and content creation and general, everyday use. The project involves comprehensive planning, from identifying system requirements to selecting the most suitable components, assembling the hardware, and conducting rigorous testing to ensure optimal performance. T

This case study delves into each step of the process to provide valuable insights and practical guidance for anyone looking to build a computer system. It highlights the importance of careful planning, informed component selection, and meticulous assembly, which are crucial for achieving a successful build. Whether you are a novice or an experienced builder, this case study will serve as a detailed roadmap to help you navigate the complexities of building a custom computer system.

The dual focus on high performance and cost-effectiveness ensures that the system meets the demanding needs of gamers and content creators and remains accessible for users requiring a reliable machine for everyday tasks such as web browsing, office applications, and media consumption. This approach demonstrates that with thoughtful selection and planning, it is possible to build a versatile computer system that balances performance and affordability.

## **Objectives**

**Understand Computer Components:**

Learn the role and importance of the motherboard, CPU, RAM, storage drive, graphics card, and power supply unit.

**Evaluate Component Selection:**

Identify key factors for choosing each component, focusing on compatibility, performance, and budget.

**Design a General-Use Computer:**

With future upgrade potential, assemble a computer system suitable for web browsing, gaming, content creation, and software development.

**Assess Simple Computer Designs:**

Evaluate the effectiveness of simple computer designs for basic and intermediate needs, noting their advantages and limitations.

**Explore Virtual Machines:**

Understand virtual machine technology, its benefits, and applications in development, testing, server consolidation, legacy support, and cloud computing.

**Provide Practical Tips:**

Offer recommendations for selecting, assembling, and maintaining computer components, and leveraging virtual machines for efficiency and flexibility.

## 1. Components Overview

Motherboard	The motherboard is the foundation of the computer, connecting all the other components. It houses the CPU, RAM, and other essential parts.
Processor (CPU)	The CPU is the computer's brain, responsible for processing data and instructions and determining the system's overall performance.
Memory (RAM)	RAM is a temporary storage for data that the CPU actively uses.  More RAM means faster multitasking and smoother performance.
Storage Drive	The storage drive stores your operating system, programs, and files. There are several storage drives, each with Advantages and disadvantages.

### 1.1. Motherboard

The motherboard serves as the main platform that connects and supports all computer components, ensuring smooth communication between the CPU, RAM, storage, and graphics card. It also contains critical elements like the BIOS, chipset, and various I/O ports that manage data flow and external device connections. The motherboard's design affects the system's performance, expandability, and overall stability. Key factors to consider when choosing a motherboard include the number of expansion slots, support for high-speed storage, the ability to handle faster RAM speeds, and efficient power delivery for demanding components.

Motherboard Selection	
<b>Form Factor</b>  The form factor determines the size and shape of the motherboard. ATX is the most common form factor for desktop computers.	<b>Socket Compatibility</b>  The motherboard must be compatible with the chosen CPU. Different CPUs have different sockets.

<b>Expansion Slots</b>	<b>Integrated Features</b>
The motherboard should have enough expansion slots for your needs, including PCIe slots for graphics cards and other peripherals.	Motherboards often include integrated features like Wi-Fi, Bluetooth, and audio. Consider these when making your decision.

## 1.2. Processor (CPU)

The CPU (Central Processing Unit) is often referred to as the "brain" of the computer. It is responsible for processing all instructions from programs and applications. Every task that the computer performs, from running software to executing commands, is managed by the CPU.

The performance of the CPU directly impacts how fast and efficient the system is. A more powerful CPU can handle complex tasks, like gaming, video editing, and software development, with greater speed and precision. CPUs come in different models, speeds, and core counts, with multi-core processors (such as quad-core or octa-core) allowing for better multitasking and faster processing. When choosing a CPU, it's important to consider factors such as clock speed (measured in GHz), number of cores, and compatibility with the motherboard.

<b>Clock Speed</b>	A higher clock speed generally indicates better performance. However, other factors such as core count and cache size are also important.
<b>Core Count</b>	The number of cores determines how many tasks the CPU can process simultaneously. More cores are beneficial for multitasking and demanding applications.
<b>Cache Size</b>	The cache is a small amount of fast memory that the CPU uses to store frequently accessed data. A larger cache can improve performance.
<b>Power Consumption</b>	Consider the power consumption of the CPU, especially if you are concerned about energy efficiency.

When choosing a CPU, consider what the computer will be used for. For simple tasks like browsing or using office apps, a basic CPU like Intel Core i3 or AMD Ryzen 3 is sufficient. For a mid-range CPU like Intel Core i5 or AMD Ryzen 5 is more suitable. For heavy tasks, there is a more powerful CPU like Core i7 or Ryzen 7/9. Ensure the CPU is compatible with your motherboard. Look at the clock speed for faster performance, especially in gaming, and consider the number of cores for better multitasking. Choose a CPU that fits your budget and motherboard.

### 1.3. Memory (RAM) Considerations

When choosing RAM, consider how much you need based on your tasks. For basic use, 8GB is enough; for gaming or multitasking, go for 16GB; and for heavy tasks like video editing, 32GB or more is better. Look at the speed of 2400MHz to 3200MHz is fine for most users, but higher speeds like 3600MHz work better for gamers and content creators. Ensure compatibility with your motherboard, as it may support specific speeds and types (e.g., DDR4, DDR5). Also, consider dual-channel RAM for improved performance, as it allows for faster data access by using two memory modules instead of one. Finally, make sure the RAM fits within your budget and future needs for potential upgrades.

RAM Type	DDR4 and DDR5 are the current standard RAM types. DDR5 offers higher speeds and lower power consumption.
Frequency	Higher frequency means faster data transfer rates. Look for RAM with a frequency of at least 2400 MHz for optimal performance.
Capacity	The amount of RAM needed depends on your usage. For basic computing, 8GB is sufficient. For gaming and demanding applications, 16GB or more is recommended.

### 1.4. Storage Drive

A storage drive is an important part of a computer that stores data, files, and programs. It helps the computer save and find information quickly, which affects how well the system works. The right storage drive can make the computer start faster, open programs more

quickly, and access files easily. There are different types of storage with varying speeds and sizes, and newer options offer faster and more reliable performance. Storage is essential not only for the operating system and applications but also for personal files, including documents, photos, videos, and backups. Choosing the best storage depends on the balance between speed, size, and cost.

## **1.5. Graphics Card**

A graphics card, also known as a video card, GPU (Graphics Processing Unit), or display adapter, is a crucial piece of computer hardware responsible for rendering images, videos, and animations for display. It converts data into a signal that the monitor can understand and display, providing the visuals seen on the screen. Graphics cards are used in various tasks like cryptocurrency mining, machine learning, scientific computing, etc.

### **Importance of Graphic Card Gaming**

Graphics cards are essential for gaming, as they handle the rendering of graphics and visuals.

A dedicated graphics card provides a significant performance boost for gaming.

### **Video Editing**

Video editing software requires significant processing power. A dedicated graphics card can accelerate video rendering and editing tasks.

### **3D Modeling**

3D modeling and animation software also benefit from a dedicated graphics card. It allows for faster rendering and smoother performance.

## **1.6. Power Supply**

The power supply unit (PSU) provides power to a computer by converting electrical energy from a wall outlet into the necessary voltage for components like the CPU, GPU, and



storage devices. It's important to choose a PSU with sufficient wattage to support the system's components, factoring in future upgrades. Efficiency ratings, such as 80 Plus, indicate how well the PSU converts power and how much is lost as heat. A high-quality PSU ensures system stability, reliability, and longevity.

Power Supply Unit Selection	
Wattage	Choose a power supply with enough wattage to power all your components.  Consider future upgrades and expansion plans.
Efficiency	Look for a power supply with an 80 Plus certification, indicating higher efficiency and lower power consumption.
Modular	Modular power supplies allow you to connect only the cables you need, reducing clutter and improving airflow.

## Chapter 2: Evaluating a Simple Computer Design

### Introduction

In today's technology-driven society, computers are indispensable for a wide range of tasks, from simple web browsing to complex scientific computations. While high-performance computers are necessary for demanding tasks, there is a significant need for simple, cost-effective systems that can handle everyday activities efficiently. This case study focuses on evaluating a simple computer design and analyzing its components, performance, and overall value to determine its suitability for basic computing needs.

### Objectives

To assess the performance of a simple computer design: Determine how well a basic setup can handle everyday computing tasks.

To evaluate the cost-effectiveness of the design: Analyze the balance between performance and cost, ensuring value for money.

To identify the key components required for a simple computer: Understand the essential hardware needed to build an efficient and reliable system.

## **2.1. Components Overview**

### **2.1.1. Motherboard**

The motherboard is the foundation of the computer, connecting all the other components. It houses the CPU, RAM, and other essential parts. A simple computer design requires a budgetfriendly motherboard that provides adequate support for the necessary components and offers essential features like USB ports, audio jacks, and network connectivity.

### **2.1.2. Processor (CPU)**

The CPU is the brain of the computer, responsible for processing data and instructions. For a simple computer design, an entry-level CPU like the Intel Core i3 or AMD Ryzen 3 is sufficient, offering a good balance between performance and cost. These CPUs can handle basic tasks like web browsing, word processing, and media playback efficiently.

### **2.1.3. Memory (RAM)**

RAM is temporary storage for data that the CPU is actively using. For basic use, 8GB of RAM is adequate, ensuring smooth multitasking and efficient performance for everyday tasks. Higher amounts of RAM, such as 16GB, can be considered if the user anticipates heavier multitasking or running more demanding applications.

### **2.1.4. Storage Drive**

The storage drive stores the operating system, programs, and files. A simple computer design benefits from a combination of a 256GB SSD for fast boot times and quick access

to frequently used applications, along with a 1TB HDD for additional storage. This setup provides a balance between speed and storage capacity.

### 2.1.5. Graphics Card

While a dedicated graphics card is not necessary for a simple computer design focused on basic tasks, integrated graphics within the CPU, such as Intel UHD Graphics or AMD Vega Graphics, are sufficient for handling everyday activities and light multimedia tasks.

### 2.1.6. Power Supply

The power supply unit (PSU) converts electrical energy from a wall outlet into the necessary voltage for computer components. A 400-450W PSU is adequate for a simple computer design, providing reliable power delivery while maintaining energy efficiency. It is essential to choose a PSU with an 80 Plus certification for better efficiency and lower power consumption.

## 2.2. Evaluation standard

To evaluate the simple computer design, the following criteria were considered:

1. **Performance:** Assess the system's ability to handle everyday tasks without lag or slowdowns.
2. **Cost:** Evaluate the total cost of the system and compare it to similar pre-built systems.
3. **Ease of Assembly:** Consider the simplicity of assembling the computer, ensuring it is accessible to users with basic technical knowledge.
4. **Upgrade Potential:** Determine the ease with which the system can be upgraded in the future to extend its lifespan.

## Chapter 3: Virtual Machine

### Introduction

In the modern digital landscape, virtual machines (VMs) have become a crucial technology for enhancing computing efficiency, scalability, and flexibility. A virtual machine is a software-based emulation of a physical computer that runs an operating system and applications just like a physical computer. This case study explores the concept of virtual machines, their advantages, and their practical applications.

### Objectives

1. **Understand Virtual Machine Technology:** Explore the fundamental concepts of virtual machines and their operation.
2. **Evaluate Benefits:** Assess the benefits of using virtual machines in various computing environments.
3. **Identify Use Cases:** Identify practical applications and scenarios where virtual machines provide significant advantages.

### 3.1. Virtual Machine Technology

A virtual machine is an emulated computer system created by a hypervisor or virtual machine monitor (VMM) that enables multiple operating systems to run simultaneously on a single physical machine. The hypervisor manages and allocates the hardware resources of the host machine to the VMs, ensuring each VM operates independently.

#### Types of Hypervisors

1. **Type 1 Hypervisor (Bare-Metal):** Runs directly on the host's hardware and manages guest operating systems. Examples include VMware ESXi, Microsoft Hyper-V, and Xen.

2. **Type 2 Hypervisor (Hosted):** Runs on top of an existing operating system, allowing users to create and manage VMs. Examples include VMware Workstation, Oracle VirtualBox, and Parallels Desktop.

## **3.2. Benefits of Virtual Machines**

### **Resource Efficiency**

Virtual machines allow multiple VMs to run on a single physical machine, optimizing resource utilization. This reduces the need for multiple physical servers, leading to cost savings in hardware, power, and maintenance.

### **Isolation and Security**

Each VM operates in its isolated environment, ensuring that applications and processes within one VM do not affect others. This isolation enhances security, as a compromise in one VM does not impact other VMs.

### **Flexibility and Scalability**

Virtual machines provide flexibility by allowing users to create, modify, and delete VMs as needed. They can be easily scaled up or down, providing a dynamic and adaptable computing environment.

### **Simplified Backup and Recovery**

VMs can be easily backed up and restored, simplifying disaster recovery processes. Snapshots and clones of VMs can be created to capture the current state, allowing quick rollback in case of issues.

### 3.3. Practical Applications

#### Development and Testing

Virtual machines are ideal for software development and testing environments. Developers can create multiple VMs to test different operating systems and configurations without the need for separate physical hardware.

**Server Consolidation** Organizations can consolidate multiple physical servers into virtual machines on a single host, reducing hardware costs and improving server management efficiency. Legacy.

#### Application Support

VMs can run older operating systems and applications that may not be compatible with newer hardware, extending the life of legacy software.

#### Cloud Computing

Virtual machines are the backbone of cloud computing services. Cloud providers use VMs to offer scalable and on-demand computing resources to users, enabling businesses to access infrastructure without significant upfront investments.

### 3.4. Evaluation Criteria

To evaluate the effectiveness of virtual machines, the following criteria were considered:

1. **Performance:** Check how well applications run in a VM compared to a physical machine.
2. **Cost Savings:** Look at the money saved by using VMs for combining servers and optimizing resources.
3. **Scalability:** See how easily VMs can be adjusted to meet changing demands.

4. **Management and Maintenance:** Understand how simple it is to manage and maintain a virtualized environment.