



Lec-7: 32-Bit vs 64-Bit OS

1. A 32-bit OS has 32-bit registers, and it can access 2^{32} unique memory addresses. i.e., 4GB of physical memory.
2. A 64-bit OS has 64-bit registers, and it can access 2^{64} unique memory addresses. i.e., 17,179,869,184 GB of physical memory.
3. 32-bit CPU architecture can process 32 bits of data & information.
4. 64-bit CPU architecture can process 64 bits of data & information.
5. Advantages of 64-bit over the 32-bit operating system:
 - a. **Addressable Memory:** 32-bit CPU $\rightarrow 2^{32}$ memory addresses, 64-bit CPU $\rightarrow 2^{64}$ memory addresses.
 - b. **Resource usage:** Installing more RAM on a system with a 32-bit OS doesn't impact performance. However, upgrade that system with excess RAM to the 64-bit version of Windows, and you'll notice a difference.
 - c. **Performance:** All calculations take place in the registers. When you're performing math in your code, operands are loaded from memory into registers. So, having larger registers allow you to perform larger calculations at the same time.
32-bit processor can execute 4 bytes of data in 1 instruction cycle while 64-bit means that processor can execute 8 bytes of data in 1 instruction cycle.
(In 1 sec, there could be thousands to billions of instruction cycles depending upon a processor design)
 - d. **Compatibility:** 64-bit CPU can run both 32-bit and 64-bit OS. While 32-bit CPU can only run 32-bit OS.
 - e. **Better Graphics performance:** 8-bytes graphics calculations make graphics-intensive apps run faster.

Watch this video by Lakshay: <https://youtu.be/cE6WoaUnpAM>

A 32-bit system and a 64-bit system are two different types of computer architecture, with different capabilities and limitations. Here is a detailed comparison between the two:

1. **Processor architecture:** The most significant difference between a 32-bit system and a 64-bit system is the processor architecture they use. A 32-bit system uses a 32-bit architecture, while a 64-bit system uses a 64-bit architecture. This means that the processor of a 32-bit system can handle data in 32-bit pieces, while the processor of a 64-bit system can handle data in 64-bit pieces.
2. **Addressable memory:** A 32-bit system can address up to 4 GB of memory, while a 64-bit system can address up to 16 exabytes (EB) of memory. This means that a 64-bit system can handle much larger amounts of memory than a 32-bit system, which is useful for applications that require a lot of memory, such as video editing, scientific computing, and gaming.
3. **Performance:** A 64-bit system can process more data in one cycle compared to a 32-bit system, which results in improved performance for tasks that require a lot of data processing. For example, 64-bit systems can perform calculations with larger numbers, process larger images, and run more complex software than 32-bit systems. However, for simple tasks, there may not be a noticeable difference in performance between the two.
4. **Compatibility:** A 32-bit system can run 32-bit software only, while a 64-bit system can run both 32-bit and 64-bit software. However, 64-bit software may not run on a 32-bit system. This means that if you have old software that was designed for a 32-bit system, you may not be able to run it on a 64-bit system.
5. **Security:** A 64-bit system offers enhanced security features, such as hardware-based Data Execution Prevention (DEP), which helps prevent malicious code from executing in memory. This is because 64-bit systems can address more memory than 32-bit systems, which means that they can use more advanced security features to protect the system.
6. **Power consumption:** A 32-bit system uses less power compared to a 64-bit system, as it processes data in smaller chunks. This means that 32-bit systems may be more suitable for devices with limited battery life, such as laptops and mobile devices.

In summary, the main differences between a 32-bit system and a 64-bit system are processor architecture, addressable memory, performance, compatibility, security, and power consumption. The choice between the two depends on the specific needs of the user, as well as the software and hardware they intend to use.