32-Bit

VS

64-Bit

OS

Operating System (OS):

- An operating system (OS) is System Software. Which give instruction to computer hardware and software resources. So that it provides common services for computer programs. All computer programs, excluding firmware, require an operating system to function. For hardware functions such as input and output and memory allocation.
- The operating system acts as an internal mediator between the computer hardware and programs, although the application code is usually executed directly by the hardware and frequently makes system calls to an OS function or is interrupted by it.
- The dominant desktop operating system is Microsoft Windows with a market share of around 83.3%. MacOS by Apple Inc. is in second place (11.2%), and the varieties of Linux is in third position (1.55%).
- In the mobile (smartphone and tablet combined) sector, according to third quarter 2016 data, Android by Google is dominant with 87.5 percent and a growth rate 10.3 percent per year, followed by iOS Apple with 12.1 percent and a per year decrease in market share of 5.2 percent, while other operating systems amount to just 0.3 percent. Linux distributions are dominant in the server and supercomputing sectors.


What is 32-bit and 64-bit Operating System?

32-bit Operating System:

- In computer architecture, It's a type of operating system which runs all the versions of the computer. In an operating system, 32-bit integers, memory addresses, or other data units are those that are 32 bits (4 octets) wide. Also, 32-bit CPU and ALU architectures are those that are based on registers, address buses, or data buses of that size. 32-bit micro computers are computers in which 32-bit microprocessors are the norm.

- Despite this, such processors could be labeled "32-bit," since they still had 32-bit registers and instructions able to manipulate 32-bit quantities. For example, the original Motorola 68000 had a 16-bit data ALU and a 16-bit external data bus but had 32-bit registers and a 32-bit based instruction set. Such designs were sometimes referred to as "16/32-bit".

64-bit Operating System:

- In computer architecture, 64-bit computing is the use of processors that have data path widths, integer size, and memory address widths of 64 bits (eight octets). Also, 64-bit computer architectures for central processing units (CPUs) and arithmetic logic units (ALUs) are those that are based on processor registers, address buses or data buses of that size. From the software perspective, 64-bit computing means the use of code with 64-bit virtual memory addresses.

- However, not all 64-bit instruction sets support full 64-bit virtual memory addresses; x86-64 and ARMv8, for example, support only 48 bits of virtual address, with the remaining 16 bits of the virtual address required to be all 0's or all 1's, and several 64-bit instruction sets support fewer than 64 bits of physical memory address. The term 64-bit describes a generation of computers in which 64-bit processors are the norm. 64 bits is a word size that defines certain classes of computer architecture, buses, memory and CPUs, and by extension the software that runs on them.
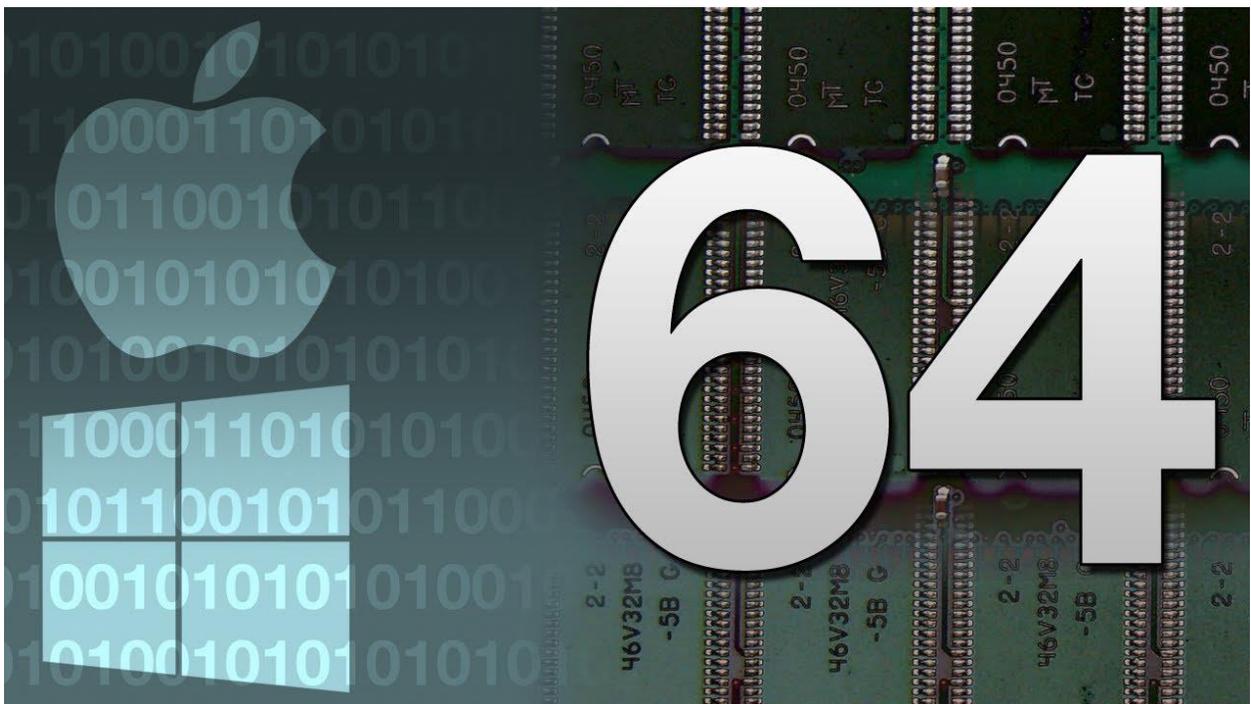
Use of 64-bit OS:

- 64-bit CPUs have been used in supercomputers since the 1970s (Cray-1, 1975) and in reduced instruction set computing (RISC) based workstations and server since the early 1990s, notably the MIPS R4000, R8000, and R10000, the DEC Alpha, the Sun UltraSPARC, and the IBM RS64 and POWER3 and later POWER microprocessors.
- In 2003, 64-bit CPUs were introduced to the (formerly 32-bit) mainstream personal computer market in the form of x86-64 processors and the PowerPC G5; and in 2012 even into the ARM architecture targeting smartphones and tablet computers.

Applications:

For 32-Bit OS:

- In this context, the term came about because DOS, Microsoft Windows, and OS/2 were originally written for the 8088/8086 or 80286, 16-bit microprocessors with a segmented address space where programs had to switch between segments to reach more than 64 kilobytes of code or data. As this is quite time-consuming in comparison to other machine operations, the performance may suffer.
- Furthermore, programming with segments tend to become complicated; special far and near keywords or memory models had to be used (with care), not only in assembly language but also in high-level languages such as Pascal, compiled BASIC, Fortran, C, etc.
- The 80386 and its successors fully support the 16-bit segments of the 80286 but also segments for 32-bit address offsets (using the new 32-bit width of the main registers). If the base address-of all 32-bit segments is set to 0, and segment registers are not used explicitly, the segmentation can be forgotten and the processor appears as having a simple linear 32-bit address space. Operating systems like Windows or OS/2 provide the possibility to run 16-bit (segmented) programs as well as 32-bit programs. The former possibility exists for backward compatibility and the latter is usually meant to be used for new software development.

For 64-Bit OS:

- On 64-bit hardware with x86-64 architecture (AMD64), most 32-bit operating systems and applications can run with no compatibility issues. While the larger address space of 64-bit architectures makes working with large data sets in applications such as digital video, scientific computing, and large databases easier, there has been considerable debate on whether they or their 32-bit compatibility modes will be faster than comparably priced 32-bit systems for other tasks.
- A compiled Java program can run on a 32- or 64-bit Java virtual machine with no modification. The lengths and precision of all the built-in types, such as char, short, int, long, float, and double, and the types that can be used as array indices, are specified by the standard and are not dependent on the underlying architecture. Java programs that run on a 64-bit Java virtual machine have access to a larger address space.

- Speed is not the only factor to consider in comparing 32-bit and 64-bit processors. Applications such as multi-tasking, stress testing, and clustering – for high-performance computing (HPC) – may be more suited to a 64-bit architecture when deployed appropriately. For this reason, 64-bit clusters have been widely deployed in large organizations, such as IBM, HP, and Microsoft.
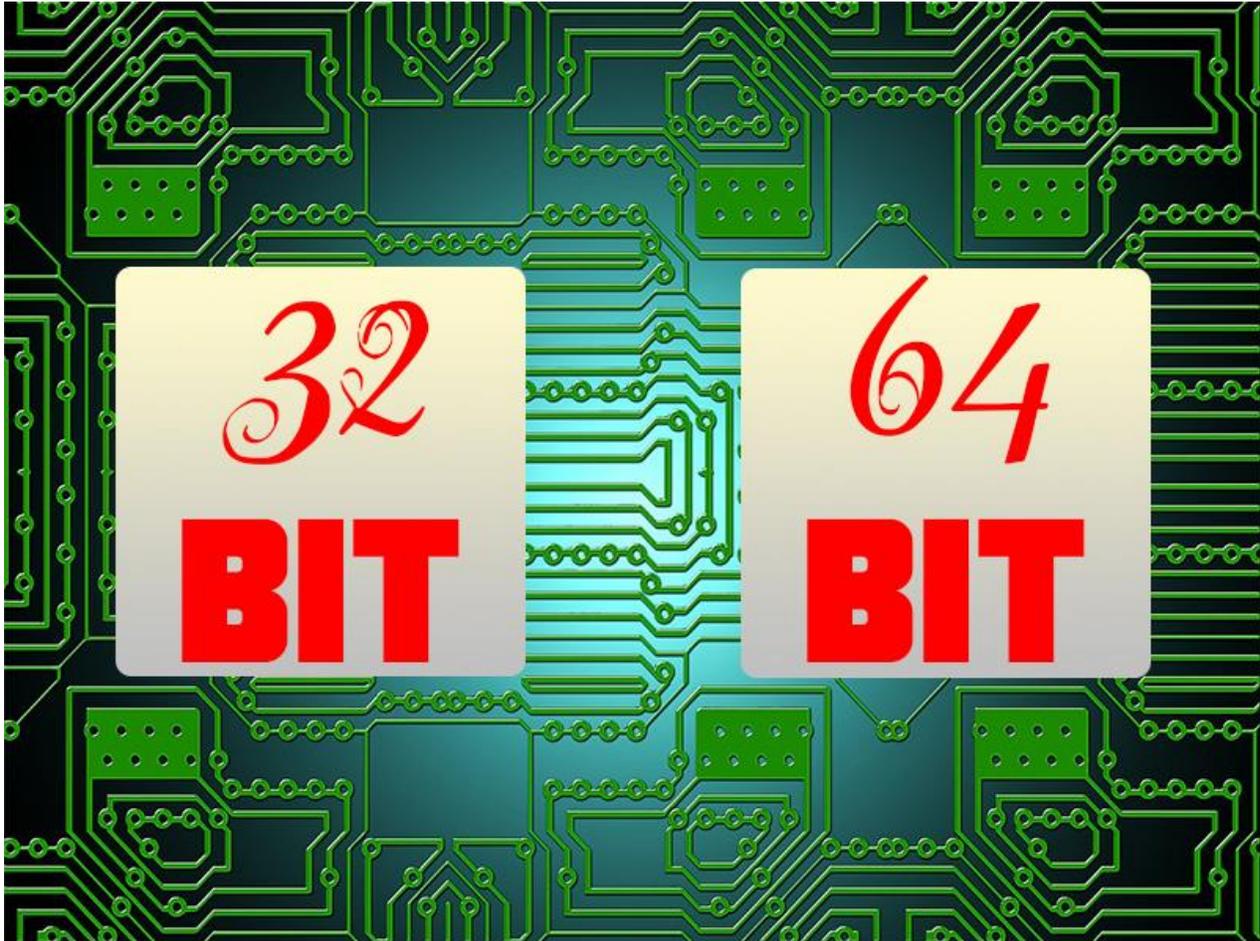
Operating System Difference:

Daytoday increase in the availability of 64-bit processor and high capacity of RAM, Microsoft and Apple both have upgraded versions of their operating systems for design it to take full advantages of the new technology.

- In the case of Microsoft Windows operating systems versions, the basic version of the systems put software limitations on the amount of RAM that can use by applications but even in the ultimate and professional version of the OS, RAM 4GB is the maximum usable memory for the 32-bit OS. So while you using 64-bit OS, you can increase the capability of a processor drastically and the real jump in power comes from software designed with this architecture in mind.

Software and Drivers:

Users are already required high-performance application software for reliable use. To take high-performance application software advantages, increase in available memory, with companies releasing 64-bit versions of their programs.

This is especially useful for:

- A program that can store a lot of information for immediate access
  - Like image editing software that opens multiple large files at the same time.
- Video games are also uniquely equipped to take advantage of 64-bit processing and the increased memory that comes with it.
  - So it able to handle more computations at once means more spaceships on screen without lagging and smoother performance from your graphics card, which doesn't have to share a memory with other processes anymore.
- Most of the software backward compatible, to allow you to run applications that are in a 64-bit environment without any extra work or issues.

32-Bit OS CPU Technology:

CPU technologies

Architecture	Turing machine, Post–Turing machine, Universal Turing machine, Quantum Turing machine, Belt machine, Stack machine, Register machine, Counter machine, Pointer machine, Random access machine, Random access stored program machine, Finite-state machine, Queue automaton, Von Neumann, Harvard (Modified), Dataflow, TTA, Cellular, Artificial neural network , Machine learning, Deep learning, Convolutional neural network, Load/store architecture, Register memory architecture, Register register architecture, DNA computing, Peptide computing, Chemical computing, Organic computing
ISA types	ASIP, CISC, RISC, EDGE (TRIPS), VLIW (EPIC), MISC, OISC, NISC, ZISC, Comparison
ISAs	x86, ARM, MIPS, Power Architecture (PowerPC), SPARC, VISC, Mill,m Itanium (IA-64), Alpha, Prism, SuperH, Clipper
Execution	- Instruction pipelining - Bubble - Operand forwarding

Parallel level	- Out-of-order execution - Register renaming - Speculative execution - Branch predictor - Memory dependence prediction - Hazards - Bit - Bit-serial - Word - Instruction - Pipelining - Scalar - Superscalar - Task - Thread - Process - Data - Vector - Memory
Multithreading	- Temporal - Simultaneous (SMT) (Hyper-threading) - Speculative (SpMT) - Preemptive - Cooperative - Clustered Multi-Thread (CMT) - Hardware scout
Flynn's taxonomy	SISD, SIMD (SWAR), SIMT, MISD, MIMD, SPMD, Addressing mode
CPU performance	- Instructions per second (IPS) - Instructions per clock (IPC) - Cycles per instruction (CPI) - Floating-point operations per second (FLOPS) - Transactions per second (TPS) - SUPS - Performance per watt - Orders of magnitude (computing) - Cache performance measurement and metric
Core count	- Single-core processor - Multi-core processor - Manycore processor

Types

- Central processing unit (CPU)
- GPGPU
- AI accelerator
- Vision processing unit (VPU)
- Vector processor
- Barrel processor
- Stream processor
- Digital signal processor (DSP)
- I/O processor/DMA controller
- Network processor
- Baseband processor
- Physics processing unit (PPU)
- Coprocessor
- Secure crypto processor
- ASIC
- FPGA
- FPOA
- CPLD
- Microcontroller
- Microprocessor
- Mobile processor
- Notebook processor
- Ultra-low-voltage processor
- Multi-core processor
- etc.

Components

- Execution unit (EU)
- Arithmetic logic unit (ALU)
- Address generation unit (AGU)
- Floating-point unit (FPU)
- Load-store unit (LSU)
- Fixed-point unit (FXU)
- Vector unit (VU)
- Branch predictor
- Branch execution unit (BEU)
- Instruction Decoder
- Instruction Scheduler
- Instruction Fetch Unit
- Instruction Dispatch Unit
- Instruction Sequencing Unit
- Unified Reservation Station
- Barrel Shifter
- Encore
- Some addressed decoder (SAD)
- Front-side bus
- Backside bus

- Northbridge (computing)
- Southbridge (computing)
- Adder (electronics)
- Binary multiplier
- Binary decoder
- Address decoder
- Multiplexer
- Demultiplexer
- Registers
- Cache
- Memory management unit (MMU)
- Input–output memory management unit (IOMMU)
- Integrated Memory Controller (IMC)
- Power Management Unit (PMU)
- Translation lookaside buffer (TLB)
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Hardware security

- Non-executable memory (NX bit)
- Bounds checking (Intel MPX)
- Intel Secure Key
- Hardware restriction (firmware)
- Software Guard Extensions (Intel SGX)
- Trusted Execution Technology
- OmniShield
- Trusted Platform Module (TPM)
- Secure crypto processor
- Hardware security module
- Hengzhi chip

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ISAs	x86, z/Architecture, ARM, MIPS, Power Architecture (PowerPC), SPARC, VISC, Mill, Ita SuperH, Clipper, VAX, Unicore, PA-RISC, MicroBlaze
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Parallel level	Bit, Bit-serial, Word, Instruction, Pipelining, ScalarSuperscalar, Task, Thread, Process, Data, V

	· Temporal
	· Simultaneous (SMT) (Hyper-threading)
	· Speculative (SpMT)
Multithreading	· Preemptive
	· Cooperative
	· Clustered Multi-Thread (CMT)
	· Hardware scout
	· SISD
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	· SPMD
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	· Single-core processor
Core count	· Multi-core processor
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Types	Central processing unit (CPU), GPGPU, AI accelerator Vision processing unit (VPU), Vector processor, Barrel processor, Stream processor, Digital signal processor (DSP), I/O processor/DMA controller, Network processor, Baseband processor, Physics processing unit (PPU), Coprocessor, Secure crypto processor, ASIC, FPGA, FPOA, CPLD, ETC.
Components	Execution unit (EU), Arithmetic logic unit (ALU), Address generation unit (AGU), Floating-point unit (FPU), Load-store unit (LSU), Fixed-point unit (FXU), Vector unit (VU), Branch predictor, Branch execution unit (BEU), Instruction Decoder,

Instruction Schedule, Instruction Fetch Uni, Instruction Dispatch Unit,
Instruction Sequencing Uni, Unified Reservation Statio, Barrel shifter, Uncore,
Sum addressed decoder (SAD), Front-side bus, Back-side bus, Northbridge (computing),
Southbridge (computing), Adder (electronics, Binary multiplier, Binary decoder,
Address decoder, Multiplexer, Demultiplexer, Registers, Cache,
Memory management unit (MMU),
Input–output memory management unit (IOMMU), Integrated Memory Controller (IMC),
Power Management Unit (PMU), Translation lookaside buffer (TLB),
Stack engine, Register file, ETC.

Power management	APM, ACPI, Dynamic frequency scaling, Dynamic voltage scaling, Clock gating

·   Non-executable memory (NX bit)

·   Bounds checking (Intel MPX)

·   Intel Secure Key

·   Hardware restriction (firmware)

·   Software Guard Extensions (Intel SGX)

Hardware security   ·   Trusted Execution Technology

·   OmniShield

·   Trusted Platform Module (TPM)

·   Secure crypto processor

·   Hardware security module

·   Hengzhi chip