INTEL ARCHITECTURE 32 BIT

Characteristics / Features of Intel Architecture:

1. Memory Access:

16-bit: Limited to a maximum of 64KB memory segments.

32-bit: Can access larger memory spaces up to 4GB.

64-bit: Allows for addressing an extensive range of memory, well beyond what is practical for most current applications.

2. Register Size:

16-bit: Operates with 16-bit registers, limiting data manipulation capabilities.

32-bit: Employs 32-bit registers, allowing for more extensive data processing and larger data values.

64-bit: Utilizes 64-bit registers, providing enhanced computational capabilities and support for larger data sets.

3. Address Bus Width / RAM:

16-bit: Supports a maximum of 2^16 (64KB) memory addresses.

32-bit: Enables addressing up to 2^32 (4GB) memory locations.

64-bit: Provides an expansive address space of 2^64, allowing access to an enormous amount of memory.

4. Data Bus Width:

16-bit: Features a 16-bit data bus, limiting the amount of data transferred in each clock cycle.

32-bit: Utilizes a wider 32-bit data bus, facilitating faster data transfer rates.

64-bit: Expands the data bus to 64 bits, enabling even more substantial data throughput.

5. Maximum Data Size:

16-bit: Processes data in 16-bit chunks, limiting data size and precision.

32-bit: Handles data in 32-bit units, offering improved precision and larger data representation.

64-bit: Processes data in 64-bit chunks, providing even greater precision and support for massive datasets.

6. Performance:

16-bit: Suitable for simpler applications and systems with limited computational demands.

32-bit: Strikes a balance between performance and memory efficiency, widely used in various applications.

64-bit: Optimized for high-performance computing, handling resource-intensive tasks with improved efficiency.

7. Compatibility:

16-bit: Older architecture primarily found in legacy systems.

32-bit: Widely used in both legacy and modern systems; still prevalent in many applications.

64-bit: Modern architecture increasingly becoming the standard, offering compatibility with 32-bit software through emulation or compatibility modes.

8. Operating System Support:

16-bit: Historically associated with early operating systems like MS-DOS.

32-bit: Supports a wide range of operating systems, including Windows, Linux, and macOS.

64-bit: Commonly used in contemporary operating systems, providing enhanced performance and addressing capabilities.

9. Instruction Set:

16-bit: Limited instruction set compared to later architectures.

32-bit: Expanded instruction set, accommodating more complex operations.

64-bit: Further augmentation of the instruction set, incorporating advanced functionalities for modern computing needs.

10. Virtual Memory:

16-bit: Limited virtual memory capabilities compared to later architectures.

32-bit: Supports more extensive virtual memory addressing, enhancing multitasking and system stability.

64-bit: Provides an expansive virtual memory space, crucial for handling complex applications and large datasets in modern computing environments.

11. Security Features:

16-bit: Basic security features with limited focus on modern security threats.

32-bit: Enhanced security features, including support for DEP (Data Execution Prevention) and NX bit.

64-bit: Introduces advanced security measures like hardware-based data execution prevention, secure boot, and virtualization support for increased system integrity.

12. Memory Protection:

16-bit: Limited memory protection mechanisms.

32-bit: Implements more robust memory protection, preventing unauthorized access and enhancing system stability.

64-bit: Enhances memory protection with features like Address Space Layout Randomization (ASLR) and hardware-enforced data execution prevention.

13. Energy Efficiency:

16-bit: Relatively lower power consumption compared to later architectures.

32-bit: Optimizations for power efficiency become more prominent.

64-bit: Continues the trend of improving energy efficiency with advanced power management features.

14. Processor Access:

16-bit Processor: Intel 8086

The Intel 8086, introduced in **1978,** is a 16-bit microprocessor and one of the earliest members of the x86 family. It had a 16-bit data bus and a 20-bit address bus, allowing it to address up to 1 MB of memory. The 8086 was widely used in early personal computers.

32-bit Processor: Intel Pentium Series

The Intel Pentium series, starting with the original Pentium processor released in **1993**, marked the shift to 32-bit architecture. The Pentium processors, such as Pentium II, Pentium III, and subsequent generations, were designed for 32-bit operating systems and applications. These processors featured a 32-bit data bus and expanded capabilities compared to their 16-bit predecessors.

64-bit Processor: Intel Core i7 Series (e.g., Intel Core i7-8700K)

The Intel Core i7 series, starting with the Nehalem microarchitecture in **2008**, represents Intel's transition to 64-bit architecture. For example, the Intel Core i7-8700K, part of the 8th generation (Coffee Lake) released in **2017**, is a 64-bit processor. These processors feature a 64-bit data bus, support for 64-bit operating systems, and increased memory addressing capabilities, allowing them to handle more significant amounts of memory.

15. Parallel Transmission:

16-bit: Limited support for parallel processing.

32-bit: Transmit 32 bit in parallel

64-bit: Transmit more than 32 bit in parallel.

16. Cost:

16-bit: Cheaper than 32 and 64 bit

32-bit: Cheap in price

64-bit: Expensive than 16 and 32 bit

17. Applications:

16-bit: 16 bit microcontroller is used in,

- ✓ Engine control system
- ✓ Medical devices i.e. pace-maker
- ✓ Remote controller
- ✓ Digital toys
- ✓ Embedded systems

32-bit: 32 bit microcontroller is used in,

- ✓ Face recognition
- ✓ Huge data processing
- ✓ Personal computer
- ✓ Office routine tasks

64-bit: 64 bit microcontroller is used in,

- ✓ Multitasking
- ✓ Personal computer
- ✓ Video and audio auditing
- ✓ Server applications

INTERNAL ARCHITECTURE OF 80386

It is divided into 3 sections.