

80286 Microprocessor

Course Teacher:

Md. Obaidur Rahman, Ph.D.

Professor

Department of Computer Science and Engineering (CSE),
Dhaka University of Engineering & Technology (DUET), Gazipur.

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Course Title: Microprocessors and Assembly Language
Department of Computer Science and Engineering (CSE),
Islamic University of Technology (IUT), Gazipur.

Lecture References:

- ▶ Book:

- ▶ *Microprocessors and Interfacing: Programming and Hardware*, Chapter # 15, **Author:** Douglas V. Hall
- ▶ *The Intel Microprocessor 8086...Arch. Prog, Interfacing.* **Author:** Bary, Bray
- ▶ *Microprocessor and Microcomputer – Based System Design*, **Author:** Mohamed Rafiquzzaman

- ▶ Lecture Materials:

- ▶ *M.A. Sattar, BUET, Dhaka, Bangladesh.*

80186 Microprocessor

- ▶ 80186 contains 8086 processor and several additional functional chips:
 - ▶ Clock generator
 - ▶ 2 independent DMA channels
 - ▶ PIC (Programmable IC)
 - ▶ 3 programmable 16-bit timers
- ▶ It is more of a microcontroller than a microprocessor
- ▶ Used mostly in industrial control applications

Intel 80286: Salient Features

- ▶ High performance microprocessor with memory management and protection
- ▶ 80286 is the first member of the family of advanced microprocessors with built-in/on-chip memory management and protection abilities primarily designed for multi-user/multitasking systems
- ▶ Available in 12.5MHz, 10MHz & 8MHz clock frequencies

Intel 80286: Salient Features

- The 80286 CPU, with its 24-bit address bus is able to address 16MB of physical memory.
- 1GB of virtual memory for each task

Microprocessor	Data bus width	Address bus width	Memory size
8086	16	20	1M
80186	16	20	1M
80286	16	24	16M

Intel 80286: Salient Features

Intel 80286 has 2 operating modes:

- **Real Address Mode :**

- 80286 is just a fast 8086 --- up to 6 times faster
- All memory management and protection mechanisms are disabled
- Similar to 8086, the maximum physical address in this mode is 1 Mbyte

- **Protected Virtual Address Mode**

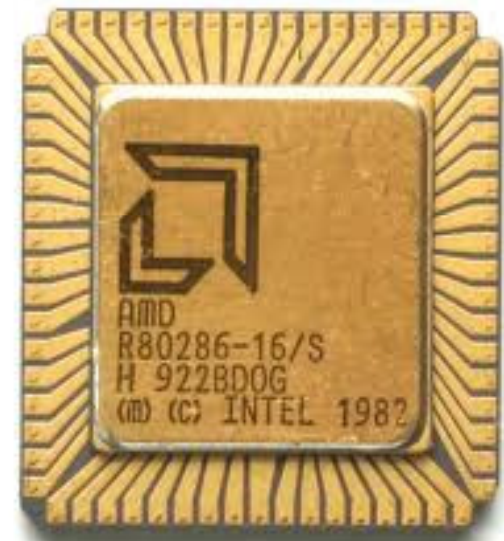
- 80286 works with all of its memory management and protection capabilities with the advanced instruction set.
- It uses all 24 address lines to access upto 16 Mbytes of physical memory and provides upto Gigabyte range virtual memory.

Memory Management Unit

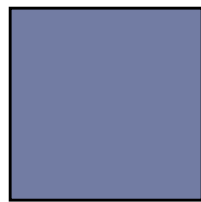
- ▶ An 80286 switches to protected mode and start using virtual memory.
- ▶ A 286 virtual address consists of a 16-bit selector and 16-bit offset.
- ▶ A memory management unit (MMU) uses 14-bits of selector to access a descriptor for the desired segment in a table of descriptors.
- ▶ The descriptor contains the 24-bit physical address.

Intel 80286: Salient Features

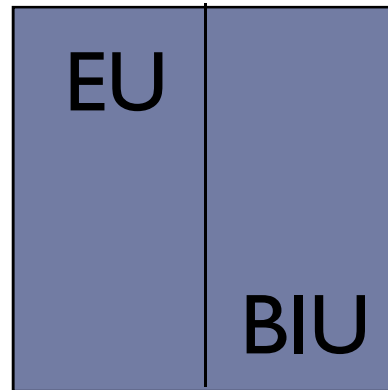
- 286 includes special instructions to support operating system.
 - for example, one instruction can
 - i) End the current task
 - ii) Save its states
 - iii) Switch to a new task
 - iv) Load its states and
 - v) Begin executing the new task
- Housed in 68-pin package
- 1,34,000 Transistors



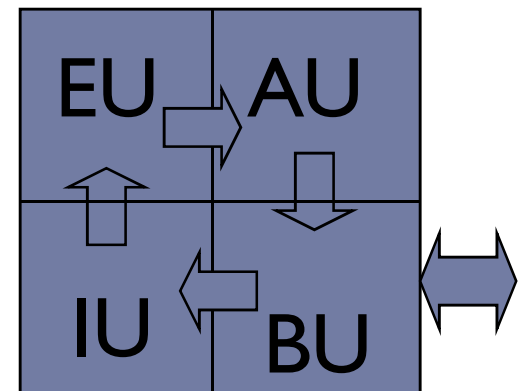
Internal Block Diagram of 80286



8085

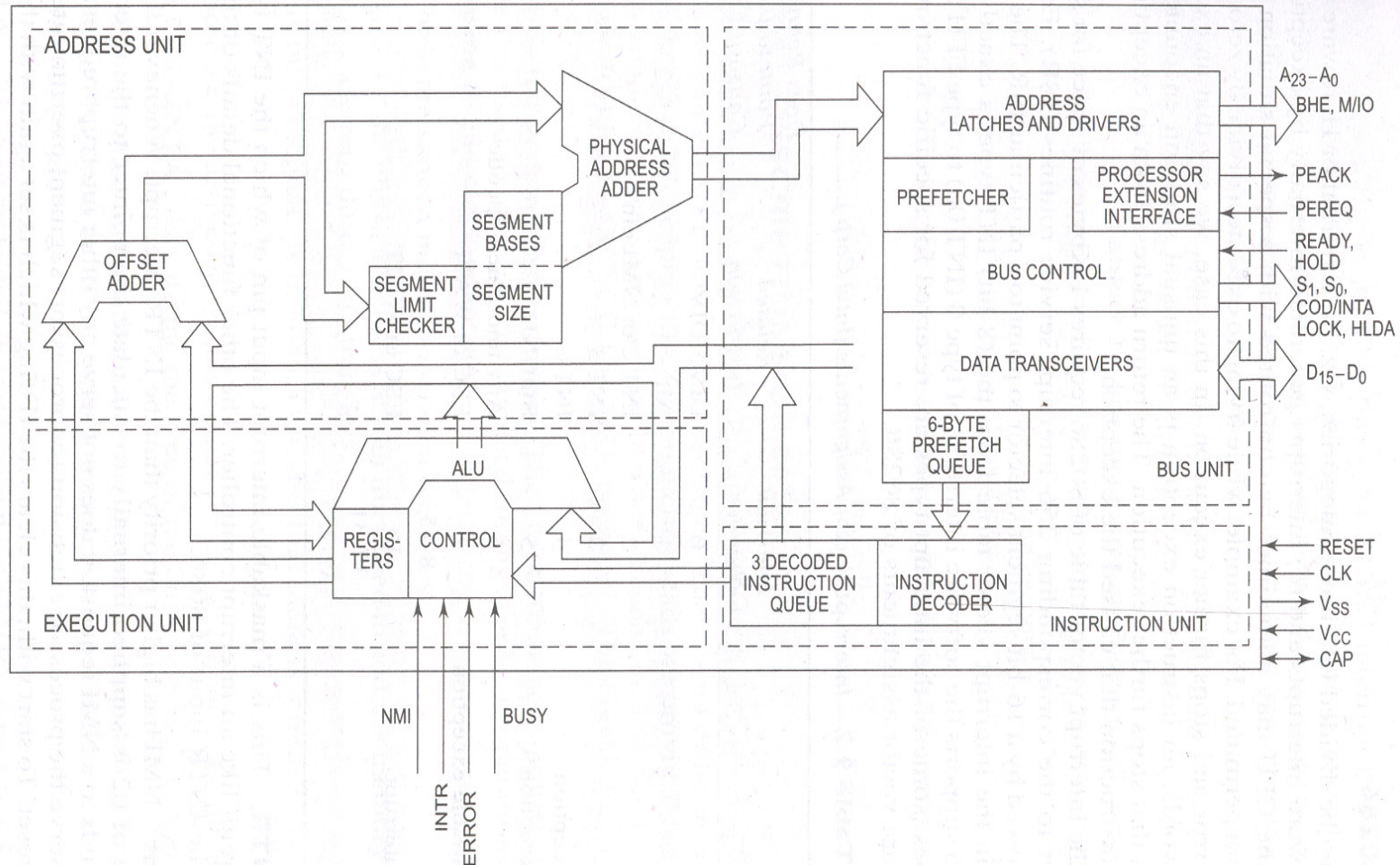


8086



80286

Internal Block Diagram of 80286



Functional Parts of 80286

- ▶ Address Unit (AU)
- ▶ Bus Unit (BU)
- ▶ Instruction Unit (IU)
- ▶ Execution Unit (EU)

Address Unit (AU)

- ▶ Calculates the physical addresses of the instruction and data that the CPU want to access
- ▶ Address lines derived by this unit may be used to address different peripherals.
- ▶ Physical address computed by the Address Unit (AU) is handed over to the BUS Unit (BU).

BUS Unit (BU)

- ▶ Performs all memory and I/O **read** and **write** operations.
- ▶ Take care of communication between CPU and a coprocessor.
- ▶ Transmit the physical address over address bus $A_0 - A_{23}$.
- ▶ Prefetcher module in the BU performs the task of prefetching.
- ▶ Bus controller controls the prefetcher module.
- ▶ Fetched instructions are arranged in a 6 – byte prefetch queue.

Instruction Unit (IU)

- ▶ IU receives arranged instructions from 6 byte prefetch queue.
- ▶ Instruction decoder decodes up to 3 prefetched instruction and are latched them onto a decoded instruction queue.
- ▶ Output of the decoding circuit drives a control circuit in the Execution Unit (EU).

Execution Unit (EU)

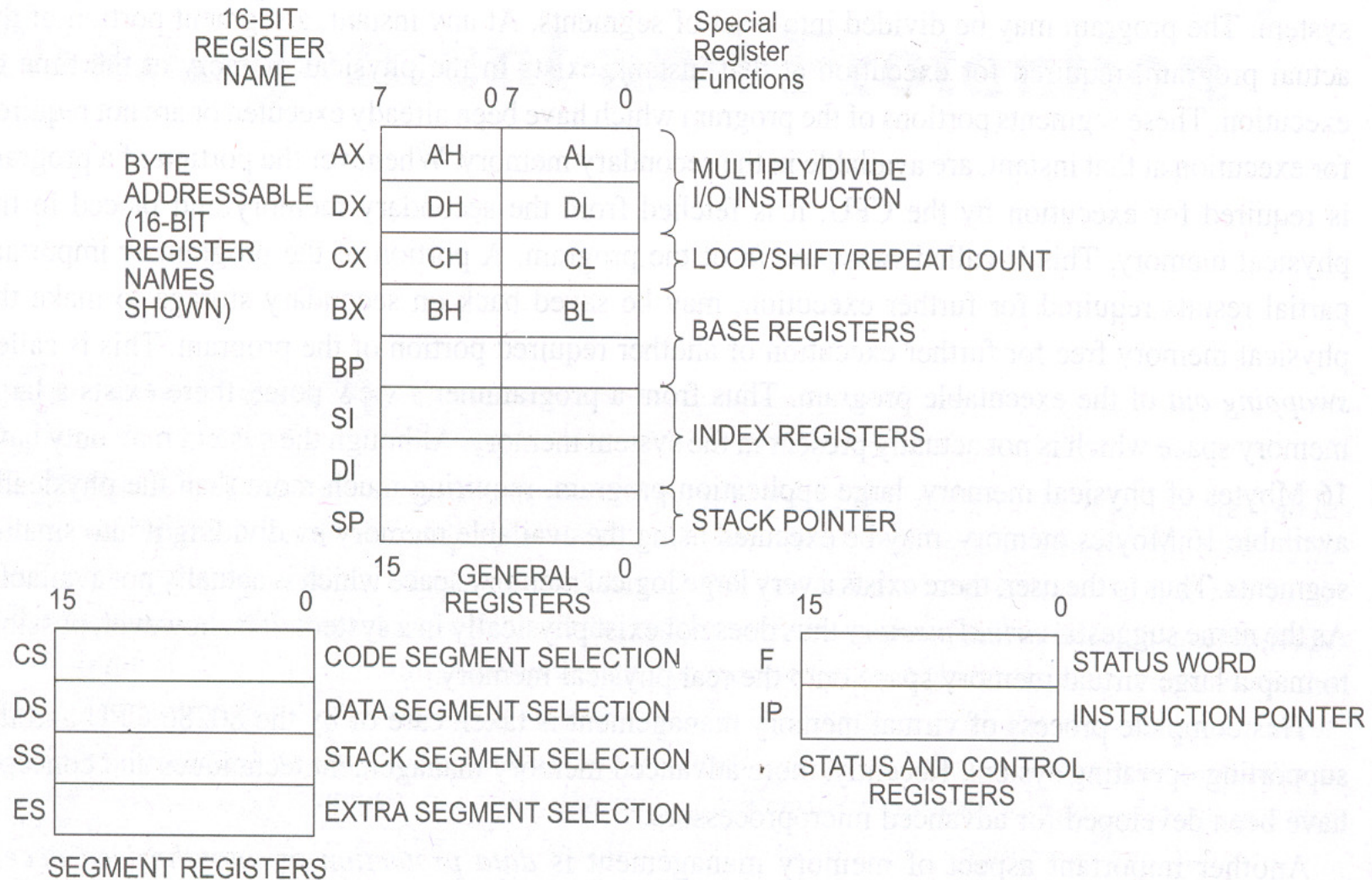
- ▶ EU executes the instructions received from the decoded instruction queue sequentially.
- ▶ Contains Register Bank.
- ▶ Contains one additional special 16-bit register called **Machine status word (MSW)** register --- lower 4 bits are only used.
- ▶ ALU is the heart of Execution Unit (EU).
- ▶ After execution ALU sends the result either over data bus or back to the register bank.

Register Organization of 80286

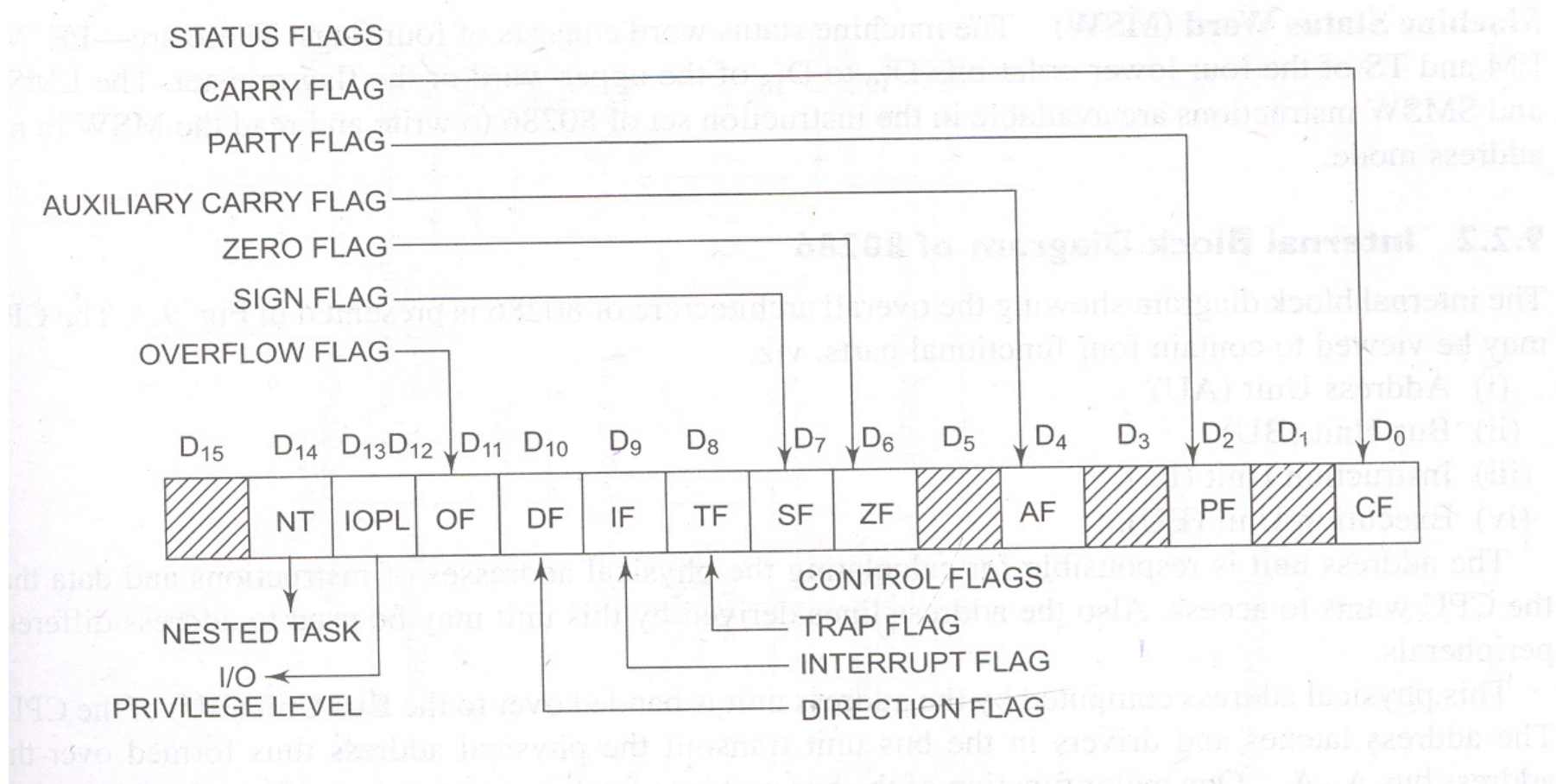
The 80286 CPU contains the same set of registers, as in 8086.

- ▶ Eight 16-bit general purpose registers (Data, Base-pointer and Index)
- ▶ Four 16 bit segment registers (Segment)
- ▶ Status and control register (Flag)
- ▶ Instruction pointer (IP)
- ▶ Machine Status Word (MSW)

Register Organization of 80286



Only Change in Flag Register



IOPL – Input Output Privilege Level Flags (Bit D_{12} and D_{13})

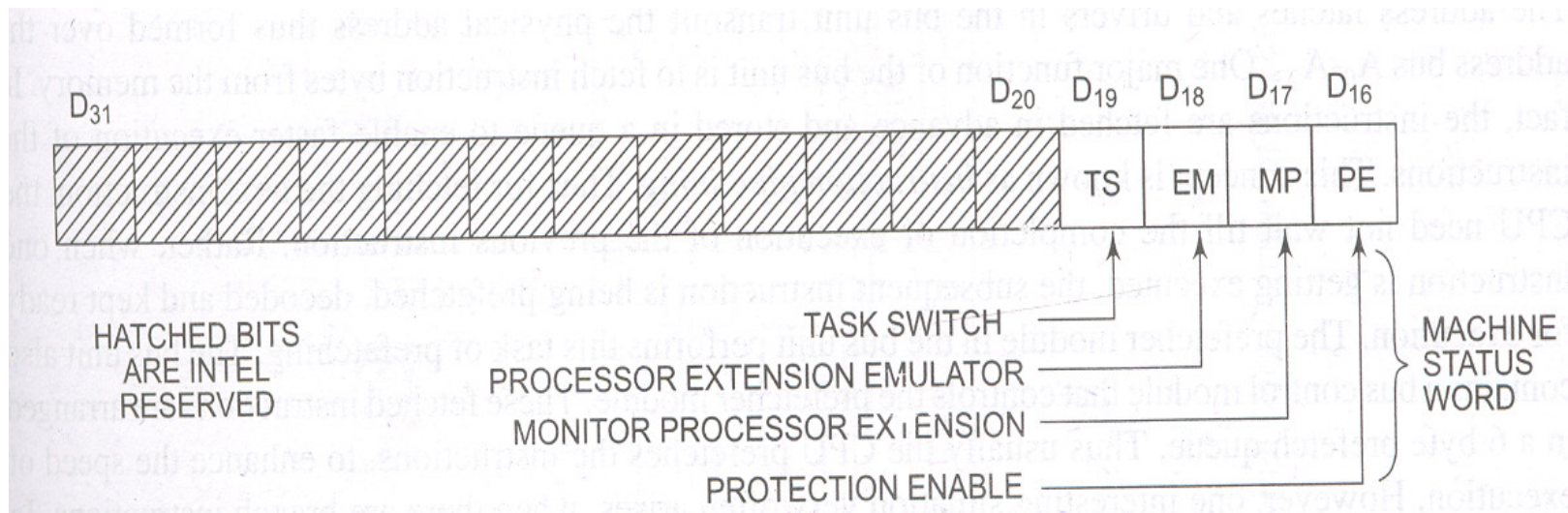
- ▶ IOPL is used in protected mode operation to select the privilege level for I/O devices.
- ▶ If the current privilege level is higher or more trusted than the IOPL, I/O is executed without hindrance.
- ▶ Note that IPOL 00 is the highest or more trusted and IOPL 11 is the lowest or least trusted.
- ▶ If the IOPL value is lower than the current privilege level, an interrupt occurs, causing execution to suspend.

NT – Nested Task Flag (Bit D₁₄)

- ▶ When NT is set, it indicates that one system task has invoked another through a CALL instruction as opposed to a JMP.
- ▶ For multitasking this can be manipulated to have advantage.

Machine Status Word (MSW) Register

- ▶ Consist of four flags. These are – **PE, MP, EM** and **TS**
- ▶ **Instructions** are available in the instruction set of 80286 to **write** and **read** the MSW in real address mode.



Machine Status Word (MSW) Register

- PE – Protection Enable
 - Protection enable flag places the 80286 in protected mode, If it is set. This can only be cleared by resetting the CPU.
- MP – Monitor Processor Extension
 - Flag allows WAIT instruction to generate a processor extension (Coprocessor).
- EM – Emulate Processor Extension Flag
 - If set , causes a processor extension (Coprocessor) is absent and permits the emulation of processor extension by CPU.
- TS – Task Switch
 - This flag permits the CPU to test whether the current processor extension is for current task or not. As the time progresses, it might be needed to change the current task; to set aside logically the segments that comprise current task and make sub-segment for another task.

Thank You !!

