CHAPTER TEN

Memory Address Space & Data Organization

Memory Segmentation:

The total memory size is divided into segments of various sizes. A segment is just an area in memory; the process of dividing memory this way is called ***Segmentation.*** In memory, data is stored as byte; "Byte-addressable" means that each byte has its own unique address.

Intel 8086 has 20 lines address bus, with 20 address lines, the memory that can be addressed is

(2^20) bytes = 1,048,576 = (1 MB)

Addresses always start at zero and go up in steps of one; so every number from zero up to 1"Meg" is an identifier or "address" of unique 8-bit storage location. Each byte has a specific address, 8086 can access memory with address ranging from 0000H to FFFFH.

Segment Registers:

In 8086, memory has four different types of segments are:

1- Code Segment

2- Data Segment

3- Stack Segment

4- Extra Segment

Each of these segments are addressed by an address stored in corresponding segment register.

These registers are 16-bit in size.

Each register stores the base address (starting address) of the corresponding segment. Because the segment registers cannot store 20 bits, they only store the upper 16 bits.

Generating a Memory Address Space (Logical & physical Address):

How is a 20-bit address obtained if there are only 16-bit registers?

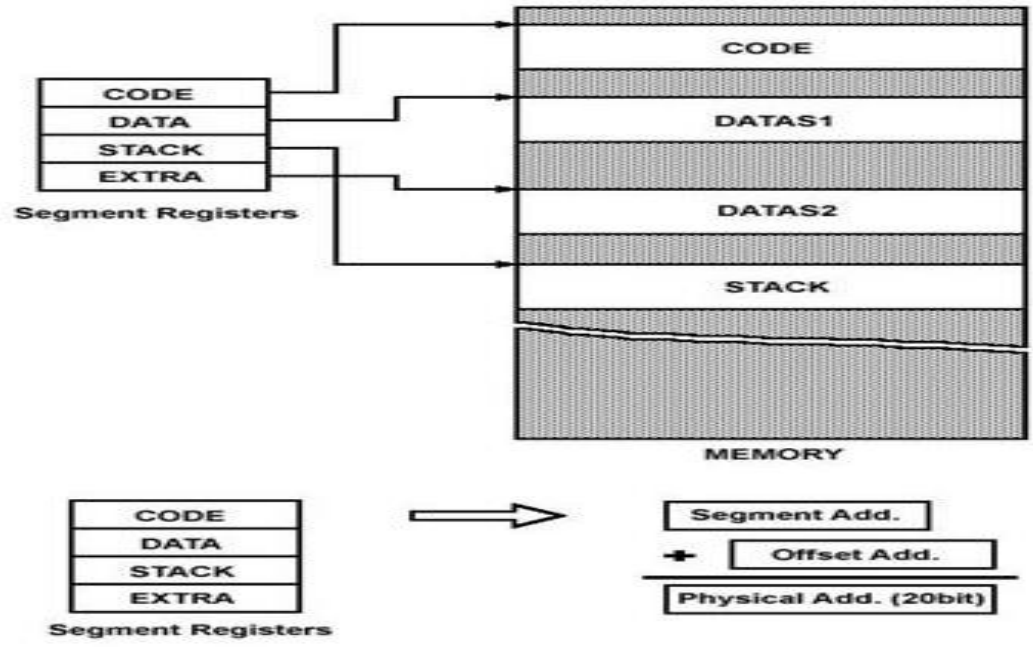
The 20-bit address of a byte is called its ***Physical Address***.

But, it is specified as a ***Logical Address.***

Logical address is in the form of:

Base Address: Offset

Offset is the displacement of the memory location from the starting location of the segment.



Example 1:

The value of Data Segment Register (DS) is 2222H.

To convert this 16-bit address into 20-bit, the BIU appends 0H to the LSBs of the address. After appending, the starting address of the Data segment becomes 22220H.

Example 2:

If the data at any location has a logical address specified as:

2222H : 0016H

Then, the number 0016H is the offset.

2222H is the value of DS.

Example 3:

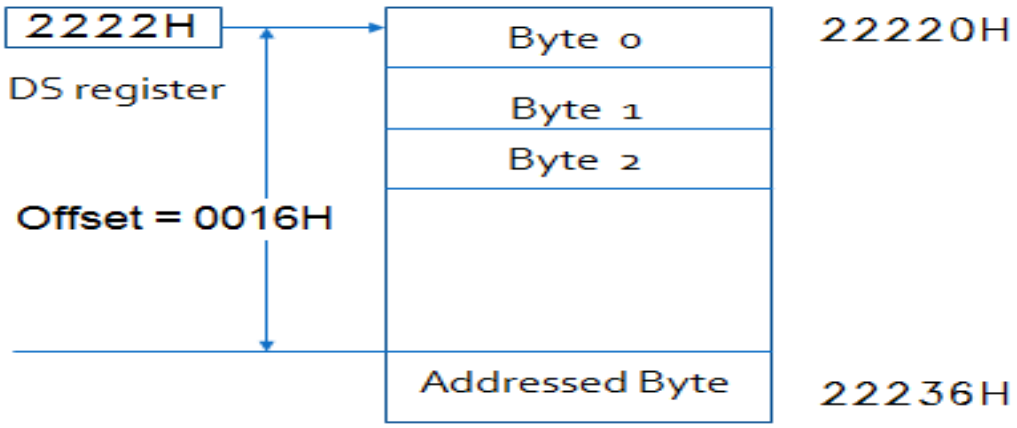
To calculate the effective address of the memory, BIU uses the following formula:

Effective Address = Starting Address of Segment*10 + Offset

To find the starting address of the segment, BIU appends the contents of Segment Register with 0H. then, it adds offset to it.

Therefore:

EA=22220H
0016H+
22236H



All offsets are limited to 16-bits. It means that the maximum size possible for segment is

2^16 = 65,535 bytes(64 KB).

The offset of the first location within the segment is 0000H.

The offset of the last location in the segment is FFFFH.

Segment	Offset Register	Function
CS	IP	Address of the next instruction
DS	BX, DI, SI	Address of data
SS	SP, BP	Address in the stack
ES	BX, DI, SI	Address of destination data (for string operations)

Question:

The contents of the following registers are:

CS = 1111H

DS = 3333H

SS = 2526H

IP = 1232H

SP = 1100H

DI = 0020H

Calculate the corresponding physical addresses for the address bytes in CS, DS and SS?

CS = 1111H

The base address of the code segment is I1110H.

Effective address of memory is given by 11110H + 1232H = 12342H.

DS = 3333H

The base address of the data segment is 33330H.

Effective address of memory is given by 33330H + 0020H = 33350H.

SS 2526H

The base address of the stack segment is 25260H.

Effective address of memory is given by 25260H + 1100H = 26360H