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8086 Memory Bank Organization:

- The memory address space of the 8086-based microcomputers has different logical and physical organizations.
- **Logically**, memory is implemented as a single **1M × 8 memory bank**. The byte-wide storage locations are assigned consecutive addresses over the range from **00000H through FFFFFH.**
- **Physically,** memory is implemented as two independent 512 Kbyte banks: the low (even) bank and the high (odd) bank.

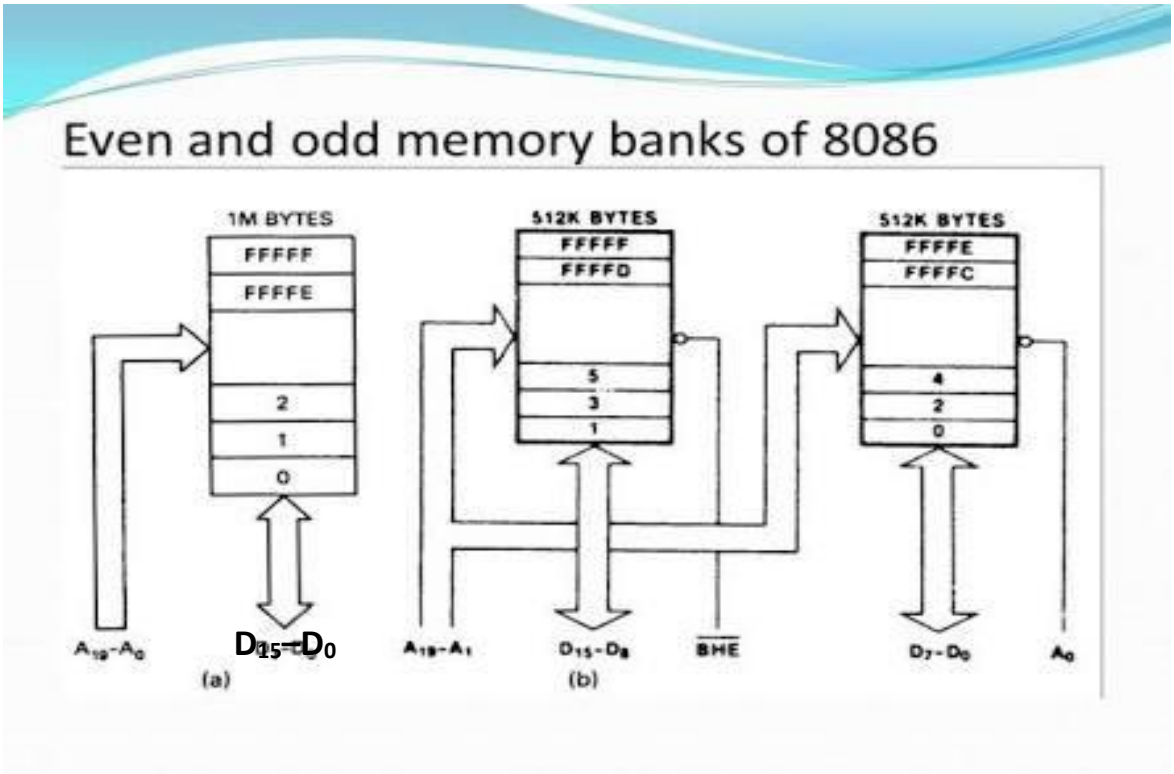

Figure 1: (a) Logical memory organization and (b) Physical memory organization (high and low memory banks) of the 8086.

- To distinguish between odd and even bytes, the CPU provides a signal called BHE (Bus High Enable).
- BHE and A0 are used to select the odd and even byte, as shown in the below table 1:

Table 1: Selection of odd and even memory bank.

$\overline{\text{BHE}}$	A0	Function
0	0	Choose both odd and even memory bank
0	1	Choose only odd memory bank
1	0	Choose only even memory bank
1	1	None is chosen

Question 1: How can 8086 read 8-bit data from an even address or 8-bit data from an odd address or 16-bit data from both even and odd addresses? Explain with 8086 instructions.

Answer 1:

Read 8-bit data from even address memory bank:

1. At first select, $\overline{BHE}$ **=1** and A_0 **=0** in memory bank (shown in Table 1). Now even address bank of 8086 will be selected.
2. Find out the physical address (PA) of a particular memory location of even address memory bank.
3. Finally, a 8-bit data (2-bit Hex data) will be moved from that memory location to lower order byte of general purpose registers (AL/BL/CL/DL)

   8086 instruction:
   MOV AL, START[BX]
   Suppose, [DS]=2000H, [START]=04H and [BX]=1200H
   So, **PA = [DS]x10H+ ([START] + [BX]) = 21204H, which is an even address.**

   Now consider, [21204H]=A9H. So that A9H data will be moved from the even address 21204H to AL. This is a read operation.

Read 8-bit data from odd address memory bank:

1. At first select, $\overline{BHE}$ **=0** and A_0 **=1** in memory bank (shown in Table 1). Now odd address bank of 8086 will be selected.
2. Find out the physical address (PA) of a particular memory location of odd address memory bank.
3. Finally, a 8-bit data (2-bit Hex data) will be moved from that memory location to higher order byte of general purpose registers (AH/BHL/CH/DH)

   8086 instruction:
   MOV AH, ARRAY[SI]

Suppose, [DS]=3000H, [ARRAY]=05H and [SI]=0300H
So, **PA = [DS]x10H+ ([ARRAY] + [SI]) = 30305H, which is an odd address.**

Now consider, [30305H]=2BH. So that 2BH data will be moved from the odd address 30305H to AH. This is a read operation.

Read 16-bit data from both even and odd addresses memory bank:

1. At first select, $\overline{BHE}$ **=0** and A_0 **=0** in memory bank (shown in Table 1). Now odd address bank of 8086 will be selected.
2. Find out the physical addresses (PA1 and PA2) of two particular memory locations of even address and odd address memory bank.
3. Finally, a two 8-bit data (two 2-bit Hex data) will be moved from that memory locations to lower order byte (AL/BL/CL/DL) and higher order byte of general-purpose registers (AH/BHL/CH/DH) respectively.

8086 instruction:
MOV CX, DISPLACEMENT[SI]
Suppose, [DS]=5000H, [DISPLACEMENT]=06H and [SI]=0600H
So, **PA = [DS]x10H+ ([DISPLACEMENT] + [SI]) = 50606H,**
PA1= 50606H, which is an even address.
PA2= (50606+1)H= 50607H, which is an odd address.

Now consider, [50606H]=8CH and [50607]=2DH. So that 8CH data will be moved from the even address 50606H to CL and 2DH data will be moved from the odd address 50607H to CH. This is a 16-bit read operation.

Solve the following Home Work (HW):

How can 8086 write 8-bit data from an even address or 8-bit data from an odd address or 16-bit data from both even and odd addresses? Explain with 8086 instructions.

Lecture prepared by

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