

# SDRAM

## Synchronous Dynamic Random Access memory

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## **RAM:**

RAM (Random Access Memory) is the hardware in a computing device where the operating system (OS), application programs and data in current use are kept so they can be quickly reached by the device's processor. RAM is the main memory in a computer. It is much faster to read from and write to than other kinds of storage, such as a hard disk drive (HDD), solid-state drive (SSD) or optical drive

# Function of RAM

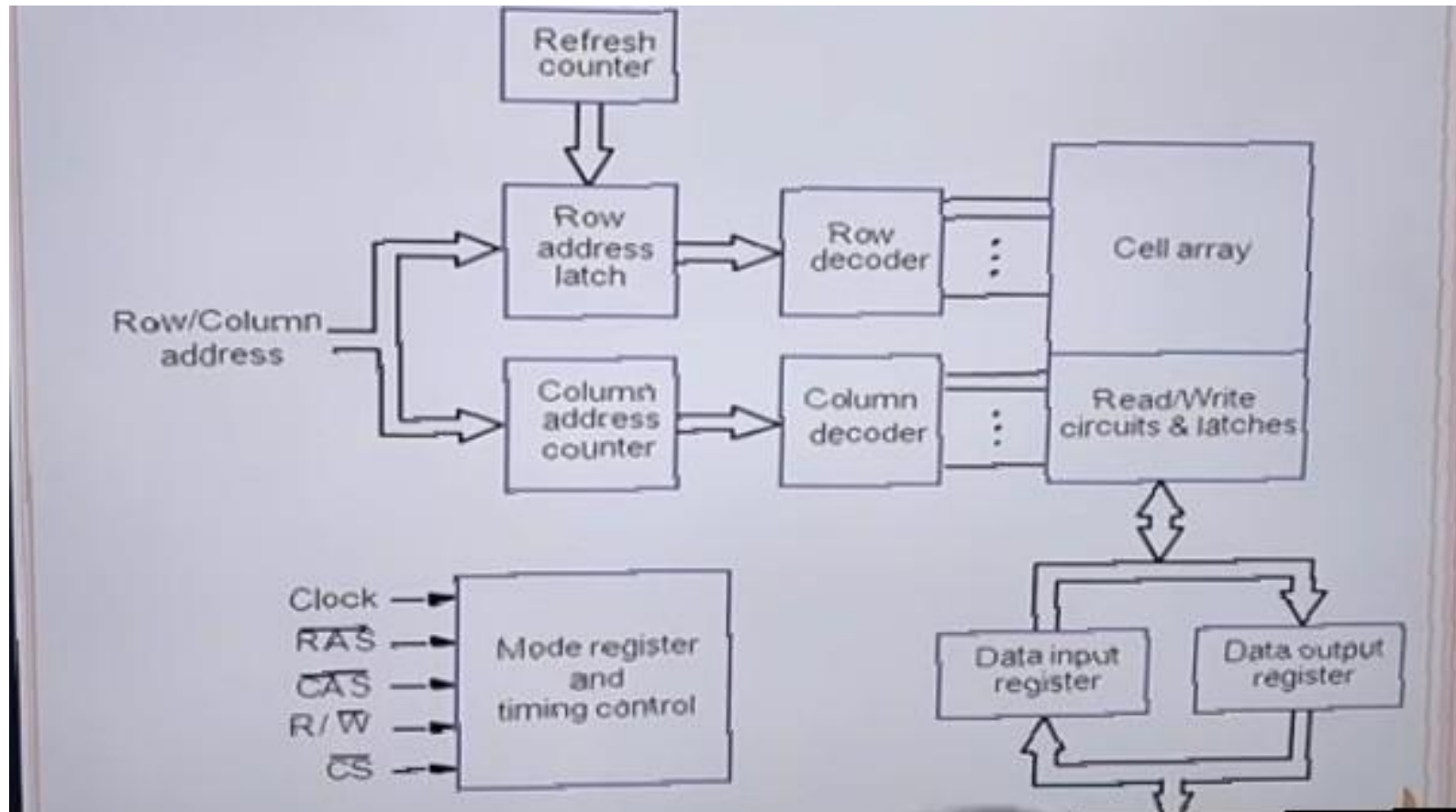
Because of its volatility, RAM can't store permanent data. RAM can be compared to a person's short-term memory, and a hard disk drive to a person's long-term memory. Short-term memory is focused on immediate work, but it can only keep a limited number of facts in view at any one time. When a person's short-term memory fills up, it can be refreshed with facts stored in the brain's long-term memory.

A computer also works this way. If RAM fills up, the computer's processor must repeatedly go to the hard disk to overlay the old data in RAM with new data. This process slows the computer's operation.

# SDRAM

- synchronous dynamic random access memory.-released in 1997.
- SDRAM is less speed compare DDR.
- It working at 3.3 volts.
- SDRAM has synchronous interface which means that it waits for clock signal to responding to the regulated input.
- SDRAM speed is considered as 66MHz ,100 MHz ,133 MHz.
- Data rate of the SDRAM is 0.8-1.3 GB/s.
- Internal rate of SDRAM is 100-166 MHz.

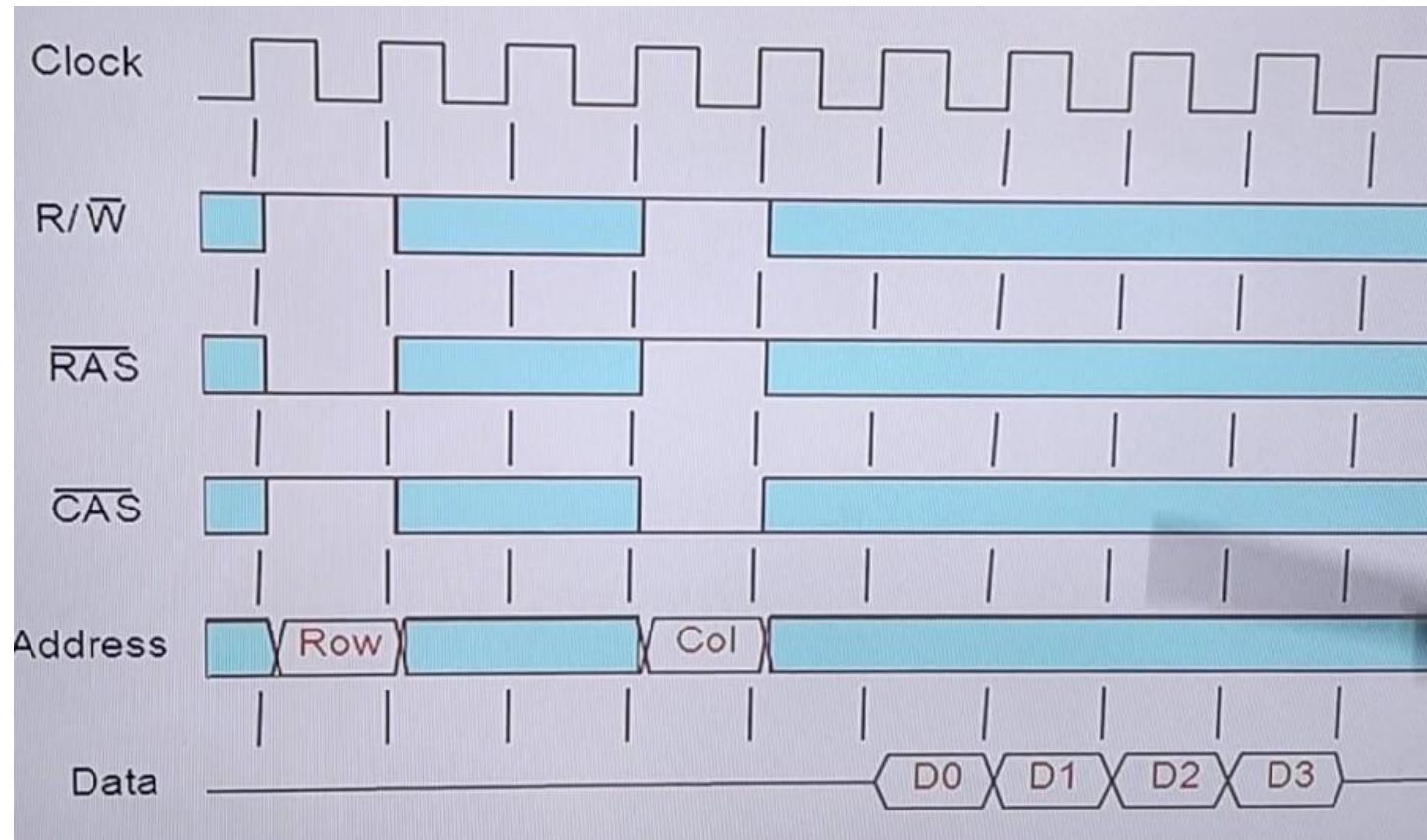
# INTERNAL ORGANIZATION



# READ AND WRITE OPERATION

- For READ operation, the row address is applied first, and in response to the column address, the data present in the latches for the selected columns are transferred to the data output register
- Then the data is available on the data bus
- o For WRITE operation, the row address is applied first, and in response to the column address, the data present in the data bus is made available to the latches through data input register
- The data is then written to the particular cell

# TIMING DIAGRAM



## Types of SDRAM

- DDR1 SDRAM
- DDR2 SDRAM
- DDR3 SDRAM
- DDR4 SDRAM





# DDR1

- **DOUBLE DATA RATE SYNCHRONOUS DYNAMIC RANDOM ACCESS MEMORY** is a class of memory integrated circuits used in computers
- Compared to single data rate(SDR) DDR1 SDRAM interface makes higher transfer rates possible by more strict control of timing of electrical data and clock signals
- Implementations often have to use schemes such as phase locked loops and self calibration to reach the required time accuracy
- With data being transferred 64 bits at a time
- $\text{Transfer rate} = (\text{memory bus} \times 2(\text{for dual rate}) \times 64(\text{no. of bits transferred per second}) / 8(\text{no of bits per byte}))$
- If the bus frequency is 100MHz,DDR1 SDRAM gives a maximum transfer rate of 1600MB/s

- DDR1 SDRAM achieves greater bandwidth than the preceding SINGLE DATA RATE(SDR SDRAM)by transferring data on the rising and falling edges of the clock signal
- Effectively it doubles the transfer rate without increasing the frequency of the clock
- The transfer rate of DDR1 SDRAM is double that of SDR SDRAM
- DDR1 SDRAM as the first generation of DDR memory has a prefetch of 2-bit,which is double that of SDR SDRAM

# DDR2 SDRAM:

- It was introduced in 2003 - successor of DDR SDRAM.
- Operates at 1.8V
- For two clock rates : 200MHz (266MHz (PC2-4200)).
- Neither forward compatible with DDR3 SDRAM nor backward compatible with DDR SDRAM.
- It operates with speed of bus clock at twice the speed of internal clock.
- Data transfer twice for each clock along with increase in bus speed will result in four data transfer per internal clock cycle ,which is twice the DDR SDRAM data transfer rate.
- So it can also provide same bandwidth as DDR SDRAM and also can provide higher latency.

## DDR3 SDRAM:

- It was introduced in 2007 - successor of DDR1 and DDR2 SDRAM.
- It is operated at 1.5V
- clock rates: 400MHz - 1066MHz .
- It uses 30% less power than its predecessor And also provides twice the data rate
- Neither forward compatible with DDR4 SDRAM nor backward compatible with DDR1 SDRAM, DDR2 SDRAM
- It operates with speed of bus clock at 4x the speed of internal clock frequency of RAM .
- RAM internal clock frequency-100Hz
- Clock frequency 400Hz
- Data rate 800MT/s ( $2 \times 400\text{Hz}$ )
- Bandwidth 1600MB/s ( $800 \times 64 / 8$ )
- Data transfer occurs 4x for each clock along with increase in bus speed will result is 8 data transfer per internal cycle ,which is twice the DDR2 SDRAM data transfer rate. So it also provides higher bandwidth and data rates.

# DDR4

- Double data rate 4th generation SDRAM.
- released in 2014.
- It is DDR3 with higher module density and lower voltage requirement higher data rate.
- Latest technologies and it is higher speed than the DDR2 and DDR3
- DDR4 is more energy efficient operating only at 1.2 v with frequency of 800 to 1600 MHz .compared DDR3 because DDR3 operates in 1.5 to 1.35 v.
- The DDR4 allows DIMM of upto 64 GB

# ADVANTAGES OF SDRAM

SDRAM offers a number of significant advantages:

- The main advantage of synchronous design is that its behavior is easy to predict, model, and validate because everything happens on a predefined schedule.
- Simple design
- Low cost
- DDR versions of SDRAM double the data rate of basic SDRAM by using both edges of the clock cycle.

## **DISADVANTAGES OF SDRAM:**

1. High power consumption
2. Volatile memory
3. Slower than SRAM

**THANK YOU**

