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## DRAM

DRAM memory is different from static ram in a sense that the cells are not bi-stable elements but just addressed capacitors holding a charge which represents the state of the cell. As this charge leaks away over time the cell needs to be read out and reprogrammed regularly. Typically this must be done each 4-100ms for the whole array. Since the state of the cell is a mere analogue voltage the technology is called dynamic. The technology has several disadvantages : Since the data is a charge which can be disturbed by internal or external events the soft error rate is higher than with other types of memory. Also the complexity of the circuits controlling the memory is much higher since the address bus is generally multiplexed and the cells must be refreshed regularly. During refresh the memory may not be available for data, dependent on the refresh scheme used. Finally dynamic ram is slower than static ram. Its only advantage over static ram is PRICE. Dynamic ram is a fourfold cheaper per bit over static ram, explaining its wide use in computer applications where large memory sizes are required as data or program memory. Today Dram's come in different technologies which are all designed to overcome one of the biggest drawback of drams : speed.

- Fast page mode (FPM) : This type was the most widespread until 1996. It used to represent over 90% of all dram sales. Fast page dram allows the system to select a row address and then a column address as usual. The page is then determined by the row address, and the system can switch within a very short time to another column address while keeping the rom address identical (within the same page).
- Nibble mode : This type allows to read or write data on 4 successive addresses in a burst mode. A row and column address is selected, and the next three locations become the logical next addresses without full addressing needing to reoccur.
- Static column mode : This type allows static addressing once a row address has been selected. As soon as this has been done (a page has been chosen) the column address can freely change without column strobing, making the device faster.
- EDO mode (Extended Data out) : This type is basically fast page memory with an added data latch which hold the data at the output while the address changes, allowing a higher memory bandwidth. This type of memory has become mainstream since 1996 or personal computers.
- SDRAM (Synchronous Dram) : This is basically a dram with a fixed clock making data transfers more precise and thus faster. SDrams come in many different technologies and can have important internal architectural differences. All SDrams are designed to boost speed. Some will be better for cpu applications, other will be more suitable for video applications. Basically SDRAM memory is FPM memory made synchronous, has several banks that can be accessed simultaneously and can accept memory handling commands.

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