Third Generation Solid State Drives

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Abstract: **solid state is a term that refers to electronic circuitry that is built entirely out of semiconductors. the term was originally used to define those electronics such as a transistor radio that used semiconductors rather than vaccum tubes in construction. A Solid state drive (SSD) is a non volatile memory system that emulates a magnetic hard disk drive (HDD).SSD depends on flash memory chips to store data ,it does not contain moving parts. With proper design, SSD provides high data transfer rates, low access time, improved tolerance to shock and vibration and reduced power consumption. The improved performance and durability outweigh the higher cost of an SSD relative to an HDD for some applications.SSD uses NANdD based flash memory or DRAM to store data.SSD uses solid state memory to store persistent data. HDDs store their data on spinning metal plateers, and whenever computer wants to access data, a little needle –like component called the "head" moves to the data's position and provides it to the computer writing data to a HDD works in a similar fashion, where parts are constantly moving, SSDs don't move. SSD process seems a bit more direct and efficient, speed is the primary advantage of an SSD over a traditional HDD.**

I. INTRODUCTION

1.1. Types of flash memory

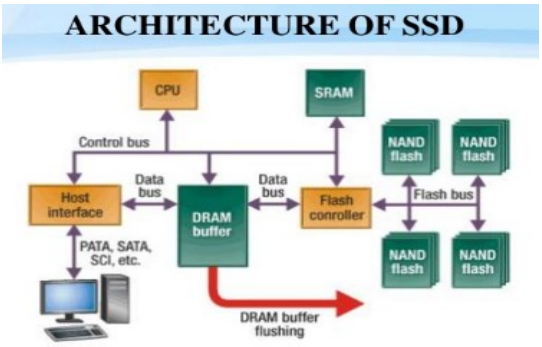
There ate two types of flash memory,NAND and NOR.NAND and NOR refers to the type of logic gate used in each memory cell.Both contain cells and transsitors in a grid but the wiring betweeb the cells differs.The cells are wired in parallel in NOR flash and the cells are wired innseries in NAND flash. NAND cell require fewer wires and can be packed on a chip in greater density.NOR cell requires more wires ,They are more complex.As a result NAND lash is less expensive and it can read and write data much more rapidly.

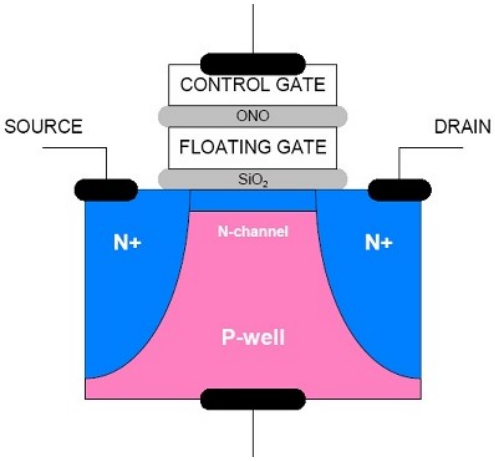
1.2 Architecture of SSD

Memory

Flash memory is an electronic (solid-state) non volatile computer storage medium that can be electrically erased and reprogrammed.

Information is stored in an array of memory cells made from floating-gate transistors in flash memory. Each cell stores only one bit of information in single –level cell (SLC) devices. Multi-level cell (MLC) devices, including triple-level cell (TLC) devices, can store more than one bit per cell.





A floating gate memory cell is a type of metal oxide semiconductor field effect transistor (MOSFET).Silicon forms the base layer, or substrate of the transistor array. Areas of the silicon are masked off and infused with different types of impurities in a process called doping. To adjust the electrical properties of the silicon impurities are carefully added.

Conductive channel is formed electrically between the source and drain terminals in MOS transistors. Electric field causes a thin negatively charges channel to form at the boundary of SiO2 and between source and drain region when a voltage is applied to the gate. The N channel disappears and no conduction takes place when the control voltage is removed. MOSFET operates like a switch, either in the ON or OFF state.

In addition to the control gate, there is a secondary floating gate which is not electrically connected to the rest of the transistor. The voltage at the control gate required for N channel formation can be changed by modifying the charge

stored on the floating gate. Electric charge can be put into and taken off the floating gate, Even though there is no electrical connection to the floating gate.

The cell is considered in the programmed state when electric charge is added to the floating gate. A charge that has been added to the floating gate will remain for a long period of time. it is the process of adding ,removing and storing electric charge on the floating gate that turns the MOSFET in to a memory cell.

Holding the control voltage at zero and by placing a high voltage on the silicon substrate the contents of the memory cells can be erased. The electron stored in the floating tunnel through the oxide barrier into the positive substrate. Thousands of memory cella is etched onto common section of the substrate, forming a single block of memory. All of the memory cells in the block are simultaneously erased when the substrate is flashed to a positive voltage. An erased memory cell will allow N channel formation at a low control gate voltage because all of the charge in the floating gate has been removed. This is referred to as logic level "1" in a single level cell (SLC) flash memory cell.

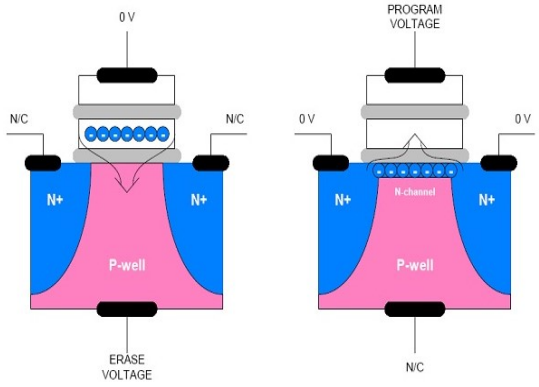


Figure 2 : Erasing and Programming the Contents of a Flash Memory Cell Via Fowler-Nordheim Tunneling

The cell is programmed by placing a high voltage on the control gate while holding the source and drain regions at zero. The high electric field causes the N channel to form and allows electrons to tunnel through the oxide barrier into the floating. programming the memory cells is performed one word at a time and is usually an entire page is programmed in a single operation. A programmed memory cell inhibits the control gate from forming an Nchannel at normal voltages because of the negative charges stored on the floating gate. To form the N channel in the substrate, the control gate voltage must be raised to a higher level. This is referred to as logic level "0" in an SLC flash memory cell.

Controller: every SSD includes a controller, just as does a HDD, that incorporates the electronics that bridge the NAND memory components to the host computer. controller is an embedded processor that executes firmware-level software.SSD controller bridgr the flash memory components to the SSD input/output interfaces. system will communicate the controller to read data from or write data to the flash memory.

1.3 Advantages of SSD

- High performance –significantly faster than a standard HDD
- Faster seek time –upto 60x faster than HDD.
- Lower power –lesser power consumption, cooler operation
- Silent operation-ideal for post production environments
- Lighter weight-perfect for portable devices.
- SSDs are random access by nature and can perform parallel reads on multiple sections of the drive.

II. CONCLUSION

SSDs use less power with faster data access. it is highly reliable. Latest high-end laptops and ultrabooks comes with SSD. In coming years SSD will replace HDD.

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