

Solid State Storage

The Good, the Bad and the Ugly.

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Solid State Drives (SSDs)

Solid State Storage is the worst form of storage...

Solid State Drives (SSDs)

Solid State Storage is the worst form of storage, except for all the others.

Inside a Solid State Drive

NAND \$\$
Non-volatile Memory

Controller \$\$\$\$

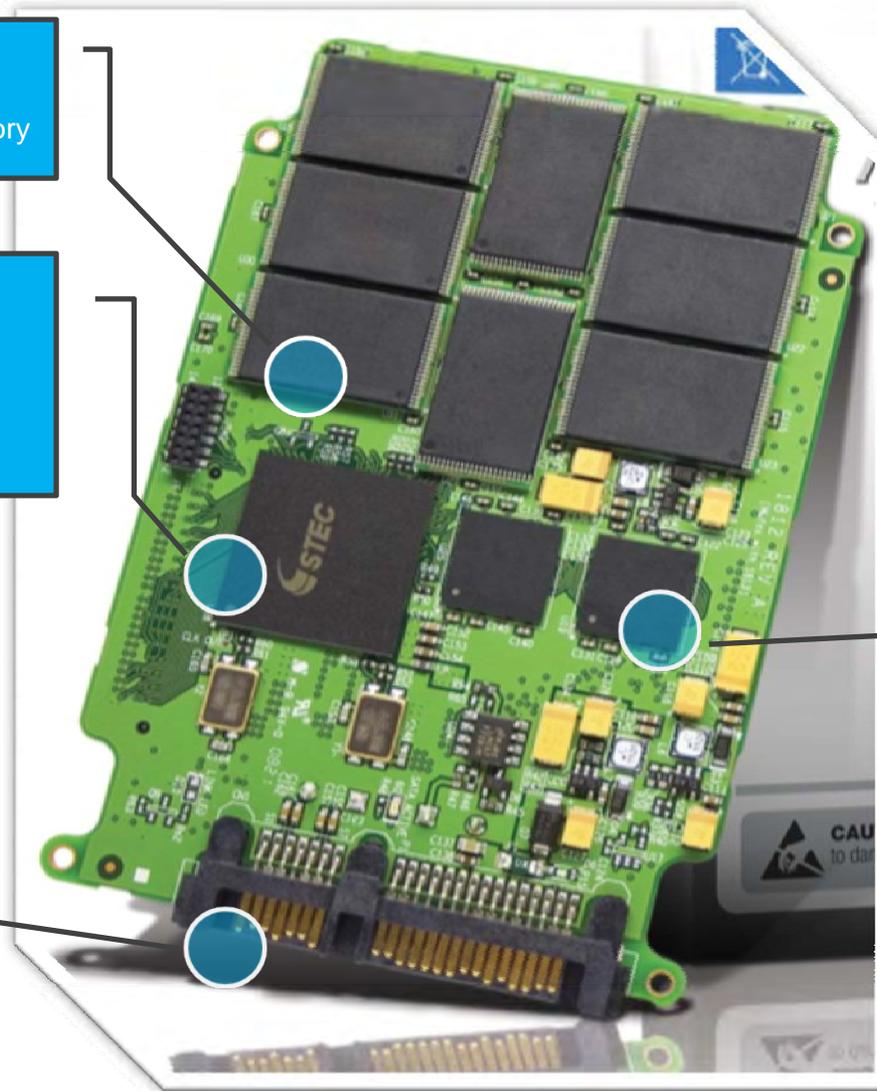
- Wear Leveling
- Error Detection & Correction
- Bad Block Management
- Power Management

Interface \$

SATA
SAS
FC
PCIe

Cache \$

High performance SSDs use DRAM to accelerate data writes and prevent data loss due to power interruption

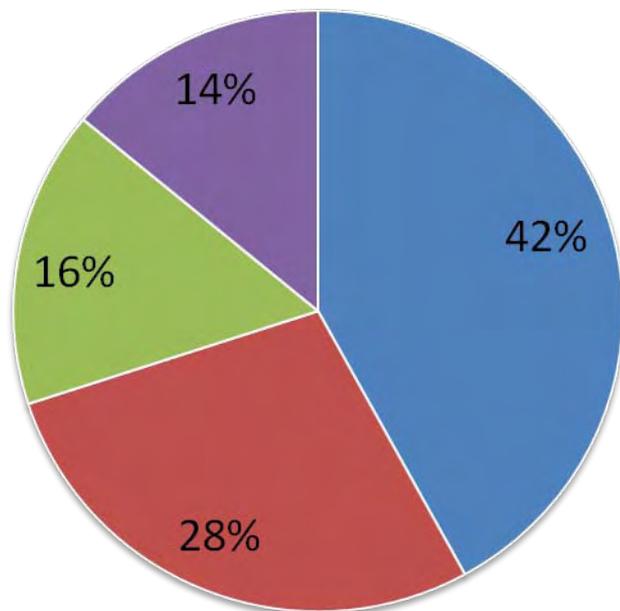


SSD Quality Grades

	Consumer	Enterprise MLC	Enterprise SLC	Industrial
				
\$/GB	\$2	\$5	\$10	+\$15
Application	Thumb Drives Smart Phones Tablets Laptops/Desktops	Desktop Direct Attached Server Attached Data Center	Data Center Cloud Financial Government	-40C to +85C Military Transportation Oil & Gas
\$ for 100GB	\$100	\$500	\$1,000	\$2,000

Most SSDs use the same memory.

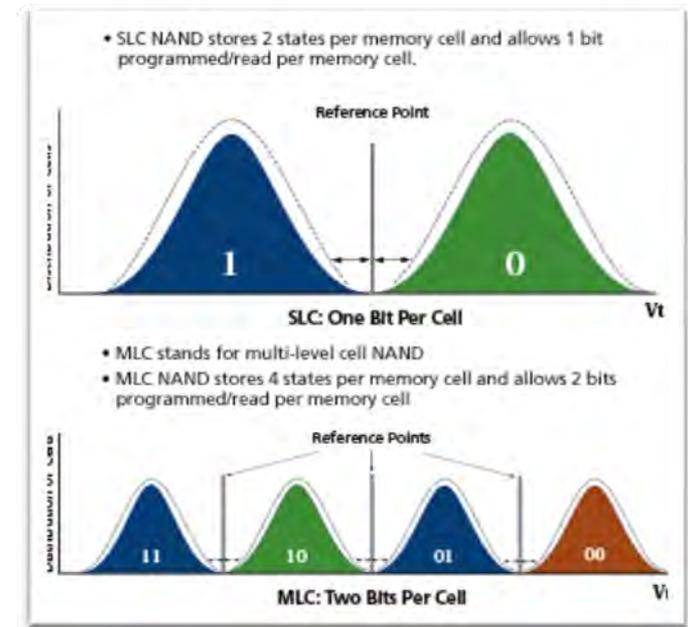
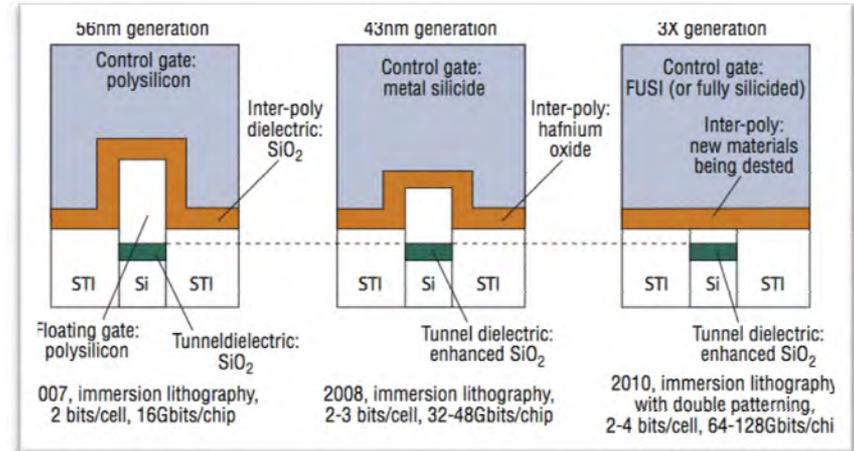
NAND Manufacturing Market Share



Source: IHS Research 2011

How do memory manufacturers differentiate?

- Physically shrink the NAND
 - More chips per silicon wafer
 - Same voltage across a smaller floating gate
- Add more bits per NAND cell
 - Multi Level Cell NAND
 - More voltage across the gate



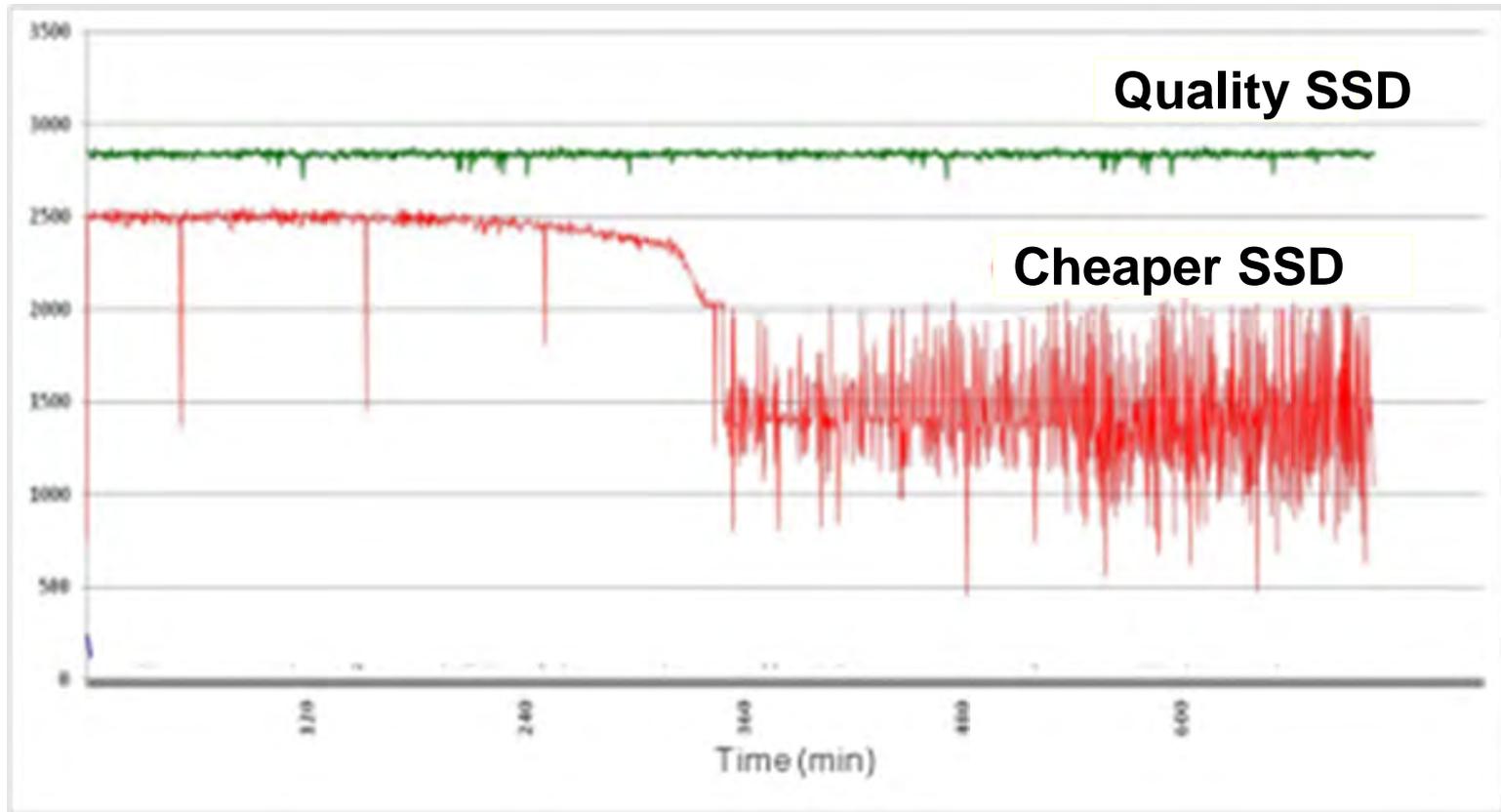
**Requires more advanced SSD
Controller technology = \$\$\$.**

How do SSD manufacturers differentiate?

- **Memory Management** (Extending Life of SSD)
 - Extends the life of flash media to deliver enterprise-class endurance through advanced signal processing and adaptive flash management algorithms.
- **Error Management** (Extending Reliability of SSD)
 - A parity stripe inside the drive allows a RAID like capability to work to recover any lost data before an error has to be reported to the host. Given the shrinking geometries of the NAND, no SSD should ever be used that does not have this capability Bad Block Management.
- **Complimentary Software** (Providing Alternative Solutions)
 - Predicts most important data and moves it from HDD to SSD

* I did not mention speed and capacity.

Why waste good money on engineers?



Out of the gate, most any SSD can achieve fast read/write speeds. The quality is recognized after you've filled up the drive.

SSD Power Advances

Consumption	Throttling	Reliability	Endurance
			
<p>Per I/O, one SSD uses about the same power as 30 HDDs.</p>	<p>User controlled thresholds for speed and power consumption.</p>	<p>RAID on SSD allows for full chip failure.</p>	<p>10 Full Write & Erase Cycles per day for 5 years.</p>

Do Solid State Drives really save money? Yes.

\$9,700 Upfront

16 Enterprise 500GB HDD



~4K IOPS
70/30 4K blocks
\$3.90 / IO

\$4,900 Upfront

1 Enterprise SSD & 4 x 2TB HDDs



~40K IOPS
70/30 4K blocks
\$0.09 / IO

Objective: Accelerate Search

Accelerate
Database Queries
Web Searches

Reduce
User Wait Times
Power & Rackspace

Do Solid State Drives really save money? Maybe.

\$9,700 Upfront

16 Enterprise HDD at 80MB/s



\$16,000 Upfront

4 Enterprise SSDs at 350MB/s



Objective: 1200MB/s Write Speed

Accelerate

Database Queries
Web Searches
Audio/Video Recording
Office Applications
Replication/Backups

Reduce

User Wait Times
Power per Transaction
Physical Footprint
Excess Drive Capacity
Cooling

Lessons from a roadside BBQ.

Price, Quality, Service.

Pick any two!

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