



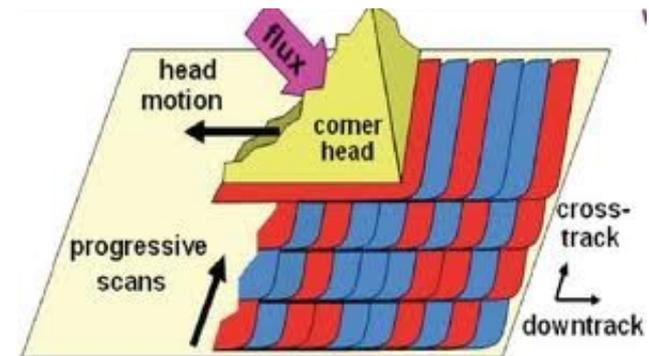
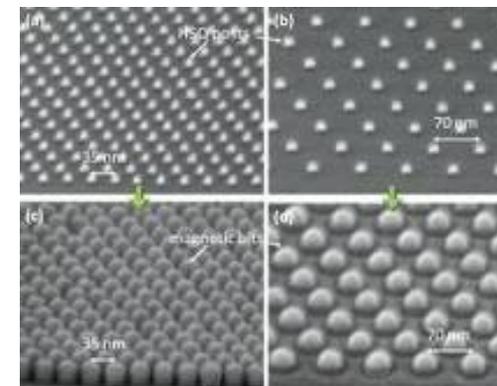
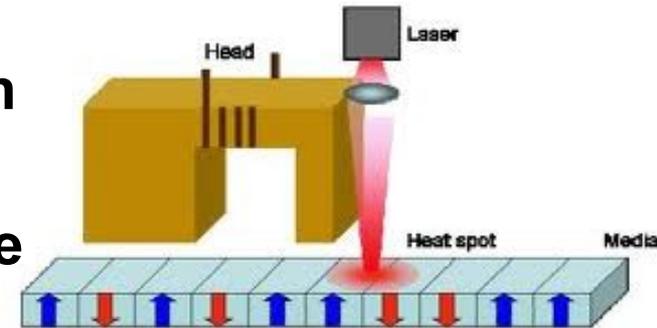
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Technology Trends

RB Hooks, III
Hardware CTO, Office of the CTO
Oracle National **Security** Group

Status of Disk Storage

- Displacement by flash technology for high IOPS
- Disk technology advances becoming more difficult
 - Future areal density increases will require new technology
 - Heat Assisted Magnetic Recording (HAMR), Bit Patterned Media (BPMR), Shingled Recording (SWR) or others
 - Require significant capital and R&D investment
- More and more industry consolidation
 - Western Digital (50% HDD shipment share)
 - Hitachi, IBM
 - Seagate (40% HDD shipment share)
 - Conner, Maxtor, Quantum, Samsung
 - Toshiba (10% HDD shipment share)
 - Fujitsu



Tape Marches On – Capacity Example

4410



1987

- 6000 carts
- STK4480 – .04 GB, 3MB/s
- 1TB Capacity
- 357 sq ft
- 8200 lbs

9310



1996

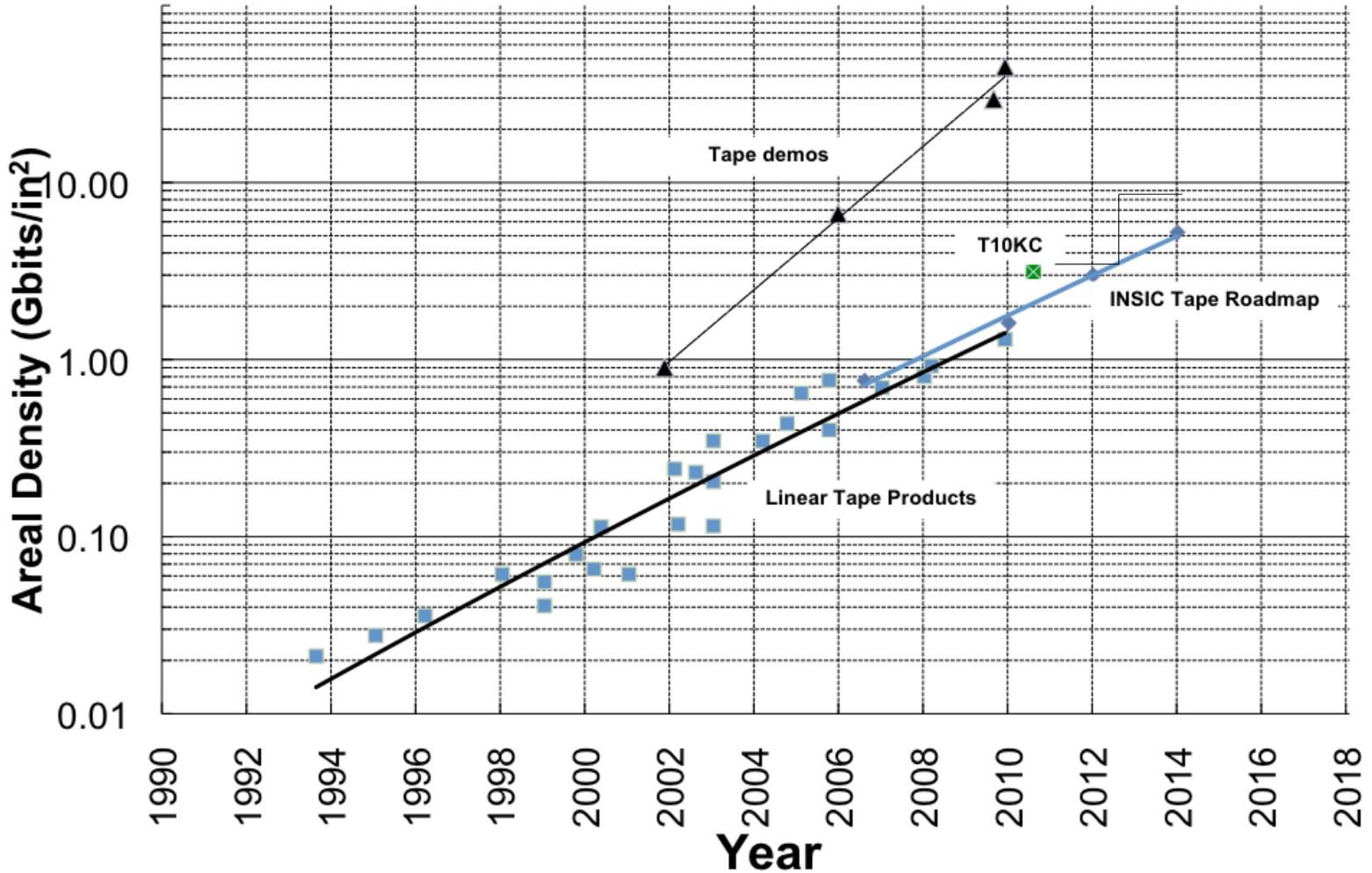
- 6000 carts
- TimberLine 9490 – 1.6 GB, 18MB/s
- 10TB Capacity
- 357 sq ft
- 8200 lbs



2011

- 2 carts
- T10000C – 5.0 TB, 240MB/s
- 10TB Capacity
- 0.3 sq ft
- 1.2 lbs

Tape Areal Density Trends



FLASH Update

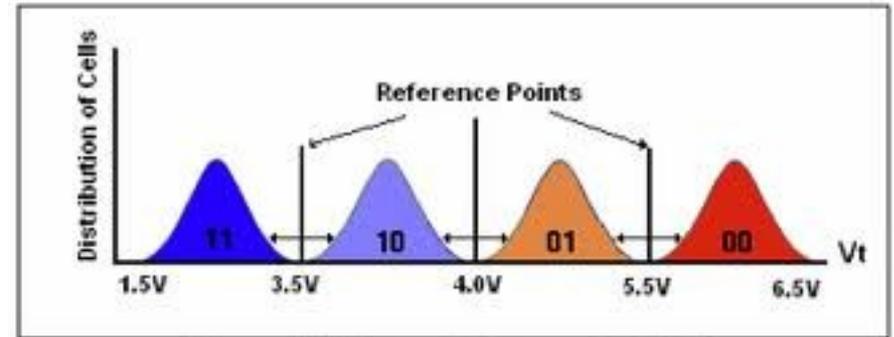
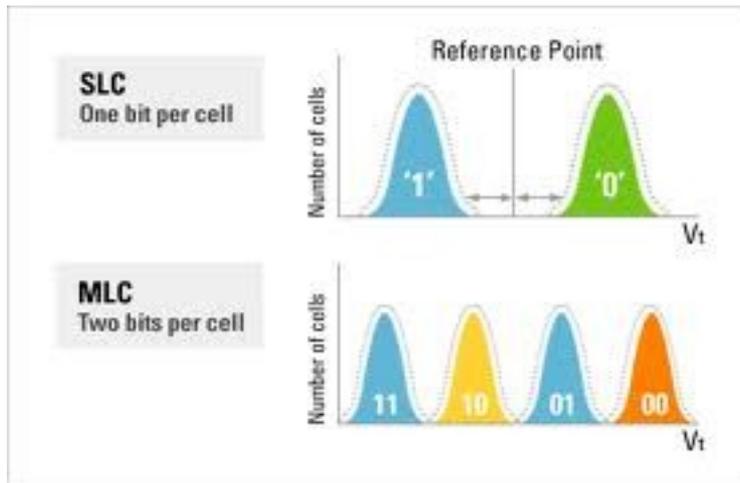
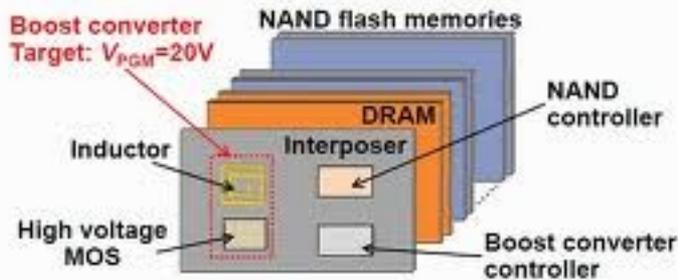


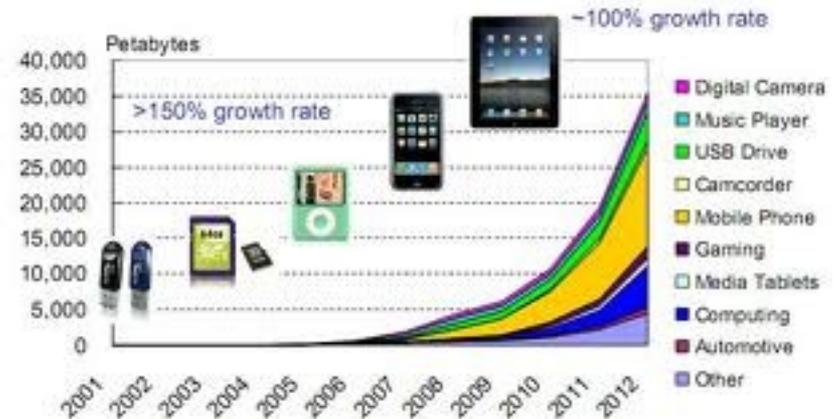
Figure 4: Voltage Reference for MLC

Concept of 3D-Solid State Drive

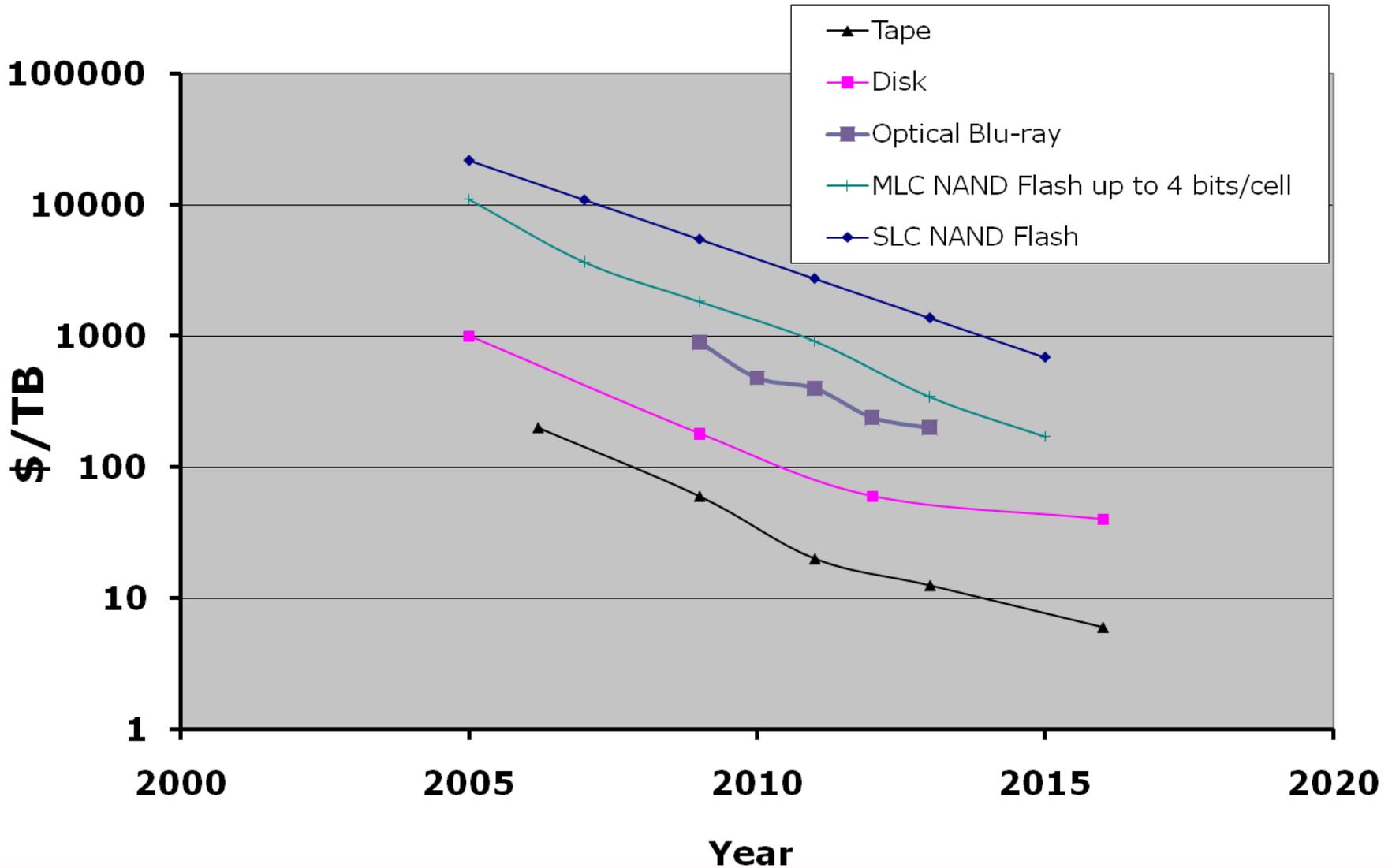
- NAND flash memories, NAND controller, DRAM and the boost converter are integrated with SiP⁽¹⁾.



- 68% energy reduction.
- 5-10% die area reduction.



Technology Component Price/GB Projections



Next-Generation Storage

Major trends shape new storage

- Storage De-capitalization
- Flash storage
- Faster CPUs
- Storage optimization
 - Consolidation
 - Virtualization

Integrated Services

- Intelligent Data Management
 - Data indexing
 - QoS
- Global Namespace
- Archiving
- Single Vendor



Hardware and Software

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