

# Key Application and Market Drivers for Flash

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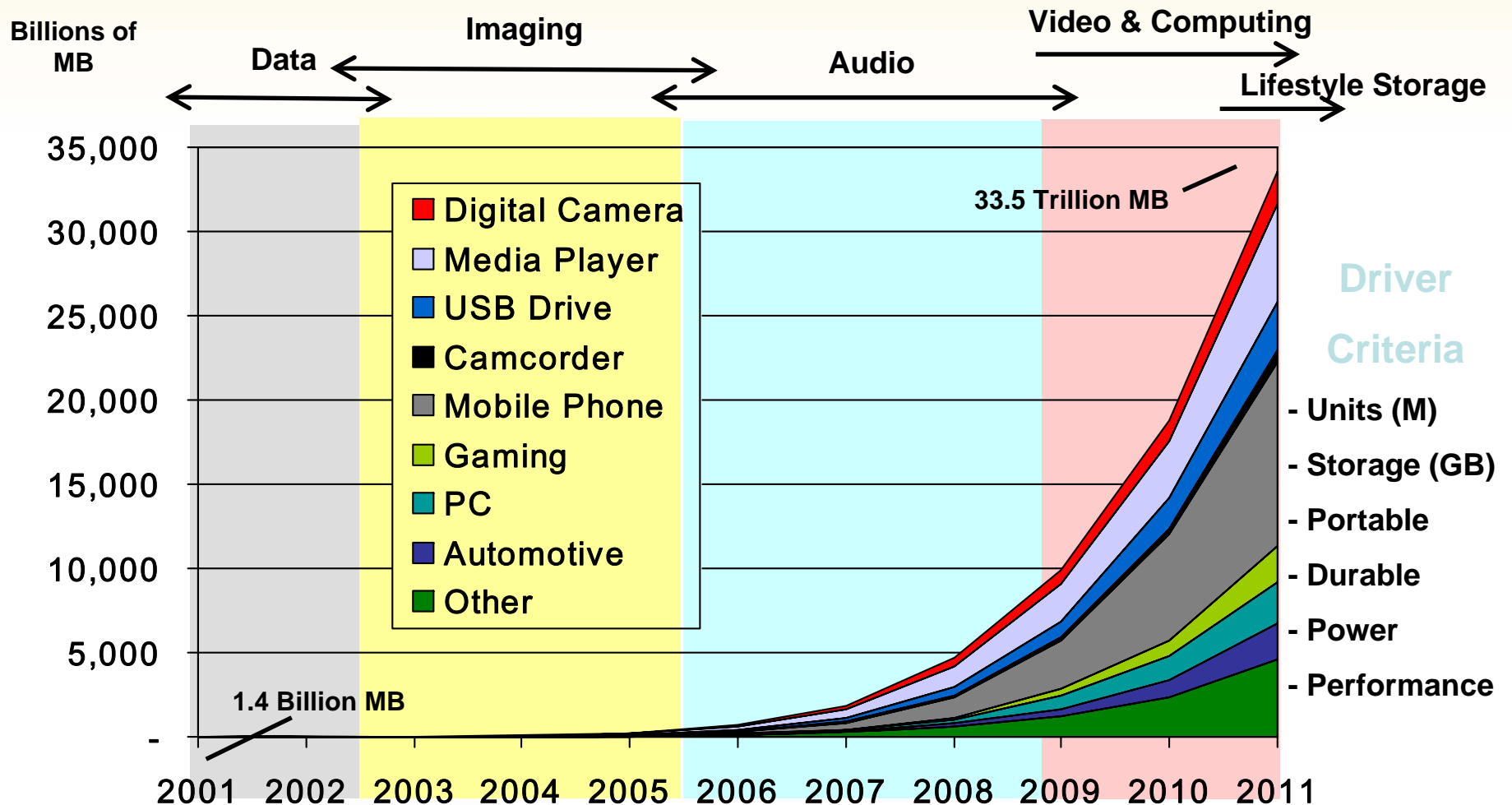
OSTA September 19, 2007

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# Forward-Looking Statement

During our meeting today we will be making forward-looking statements. Any statement that refers to expectations, projections or other characterizations of future events or circumstances is a forward-looking statement, including those relating to revenue, pricing, market share, market growth, product sales, industry trends, expenses, gross margin, production capacity and technology transitions and future products. Actual results may differ materially from those expressed in these forward-looking statements including due to the factors detailed under the caption "Risk Factors" and elsewhere in the documents we file from time-to-time with the SEC. We undertake no obligation to update these forward-looking statements, which speak only as of the date hereof.

# Past, Present, & Future NAND Flash Demand Drivers - Gartner



Note: NAND flash consumption includes both in-system and removable storage such as flash cards.

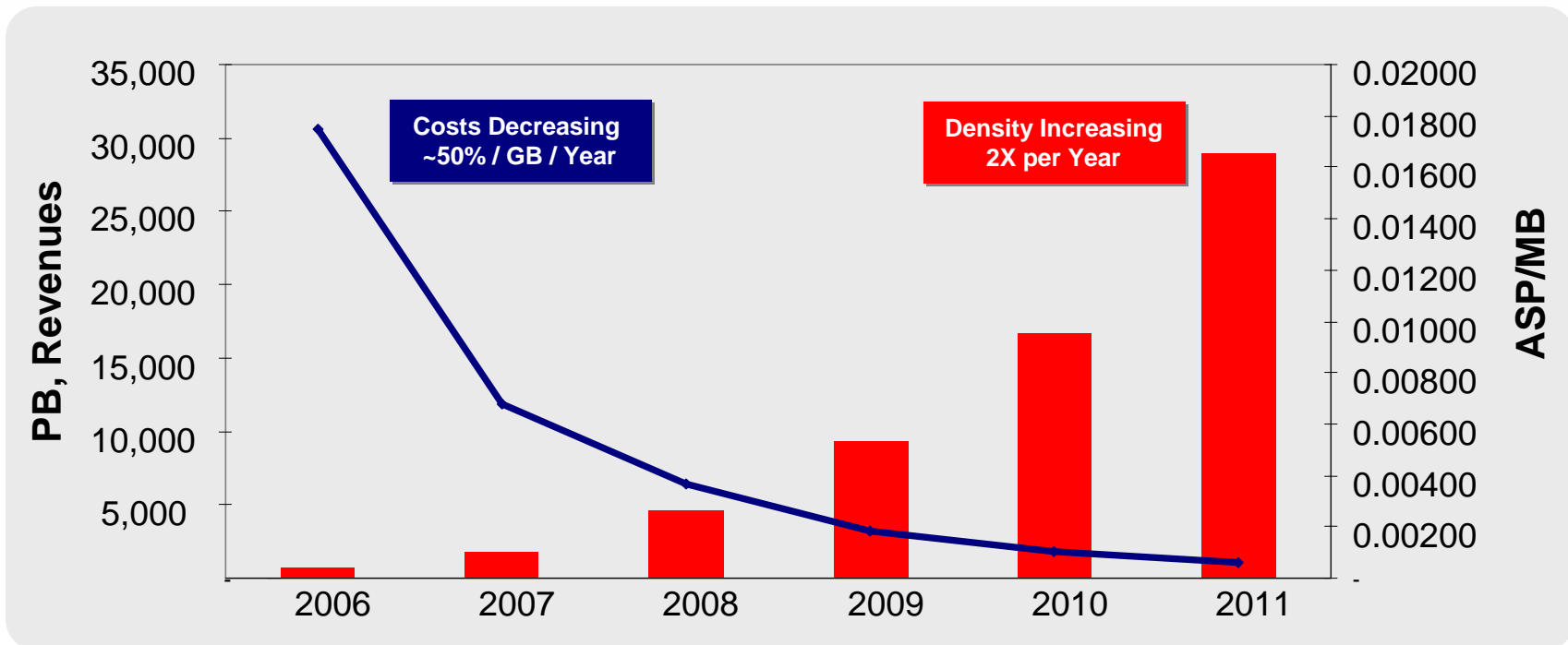
Source: Gartner Dataquest, May 2007  
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# Drastic Decline in NAND Flash Prices

- Driving both current and new applications

WW NAND projection 2006-2011

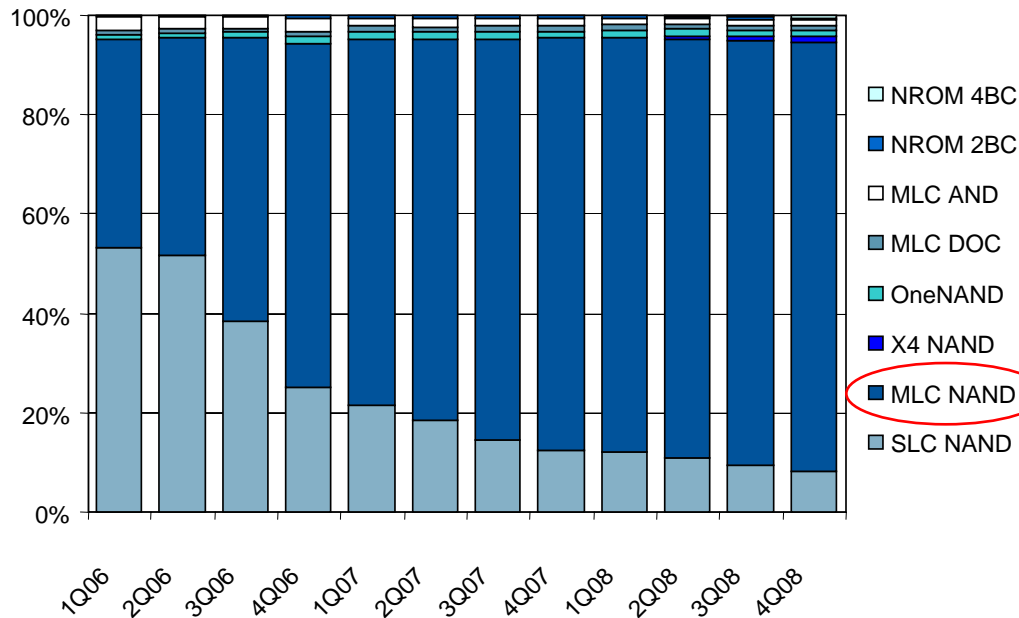


■ Total PBs  
— ASP/MB

Source: Gartner 1Q07

# Transition to Multi-level Cell Technology is Essential

Percentage of Megabyte



## • MLC Technology Adoption

-- By 2007, vendors must leverage MLC technology to stay competitive in mainstream consumer markets (0.8 probability).\*

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## • SLC Technology

-- By 2010, SLC technology will be relegated to only industrial and high end niche segments (0.8 probability).\*

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\*Source: Gartner, Inc., "NAND Flash Supply and Demand Quarterly Statistics: Worldwide, 2006-2008 1Q07" by Joe Unsworth, Gartner February 2007"

# Market Challenges of MLC NAND

## Meeting the Market Needs

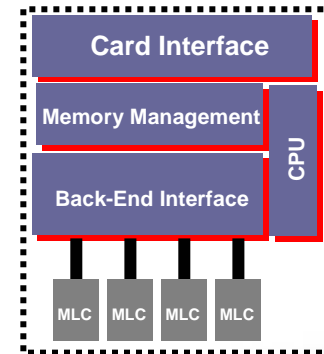
**Market Requirements**

**Performance, Endurance, Reliability**

**Raw Memory Capabilities**

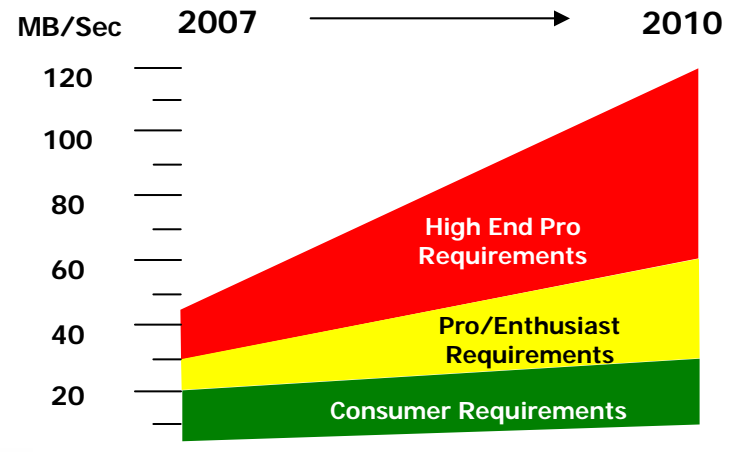
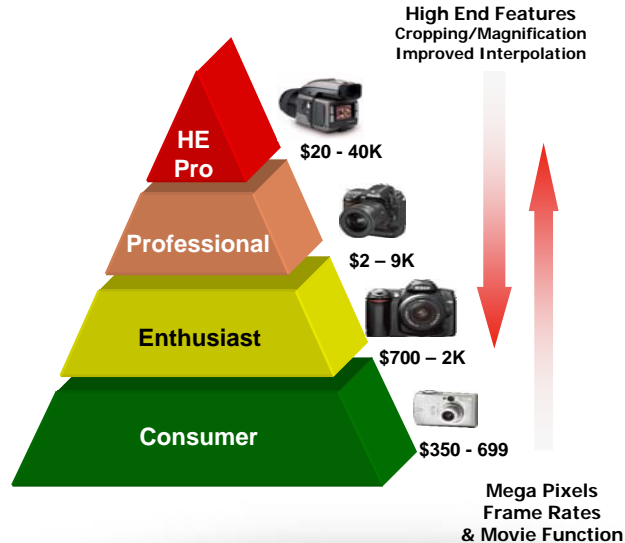
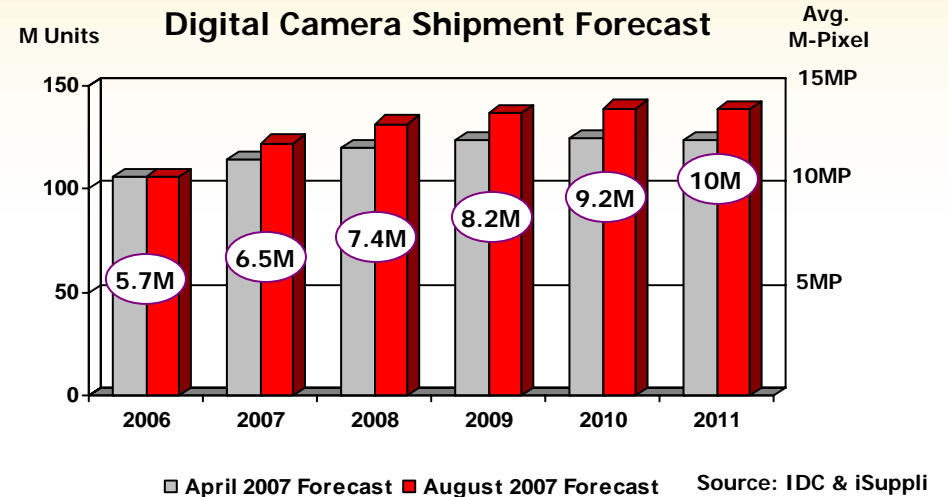
**(Smaller Geometries & Increased Bits / Cell)**

System-level Approach  
&  
Increased Parallelism Required



# Digital Imaging – Still growing after all these years

- IDC forecast raised from 114M to over 122M units in 2007
- Mega-pixels & Movie-mode driving card capacities
- DSLRs driving performance
  - High, mega-pixel capture rate



# Flash Card Trends

## Smaller form-factors



Professional Imaging



Consumer Imaging



Mobile Handsets

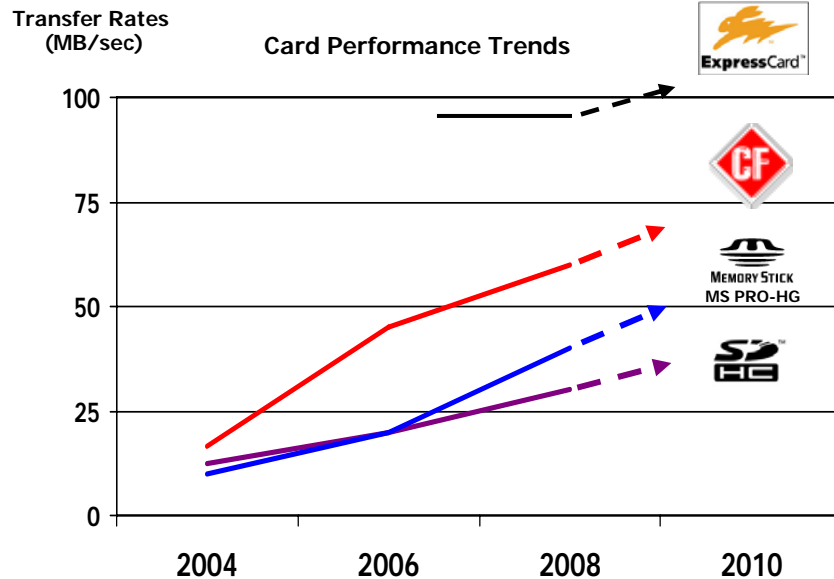
## New Markets



Professional Video



## Higher Performance

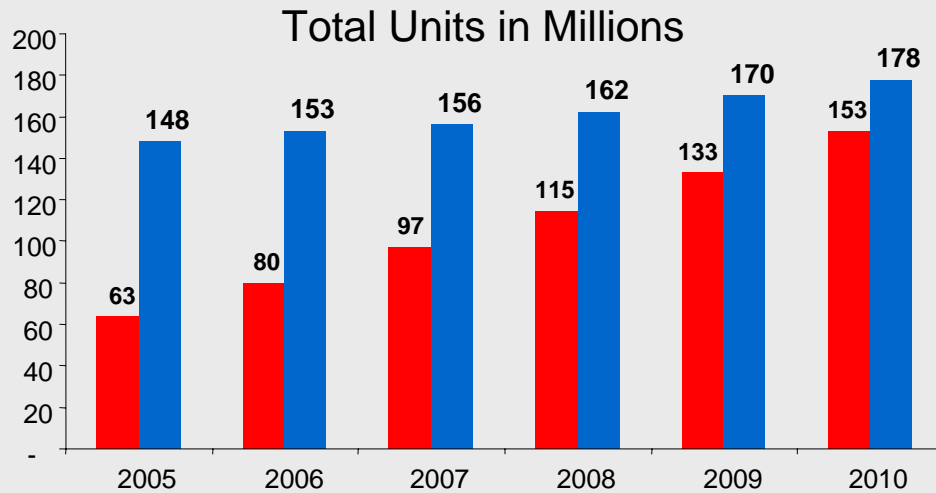




# SSD - From Fighter Jets to Laptops

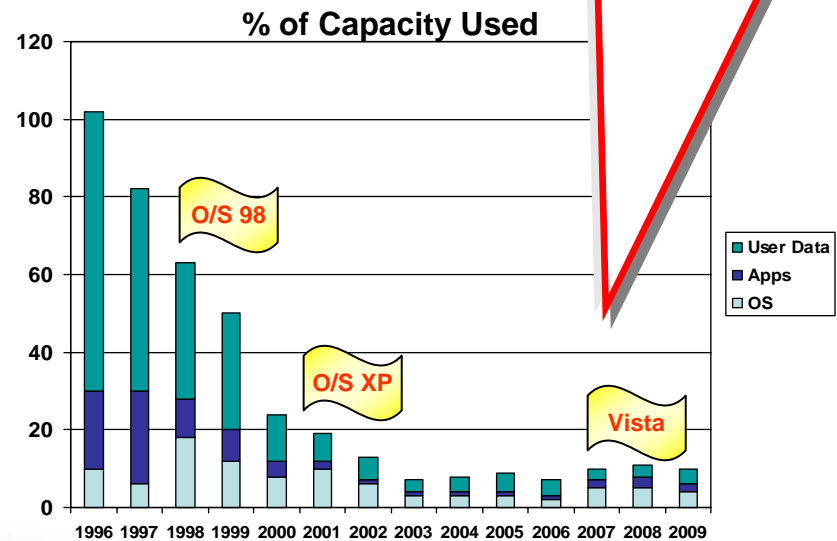
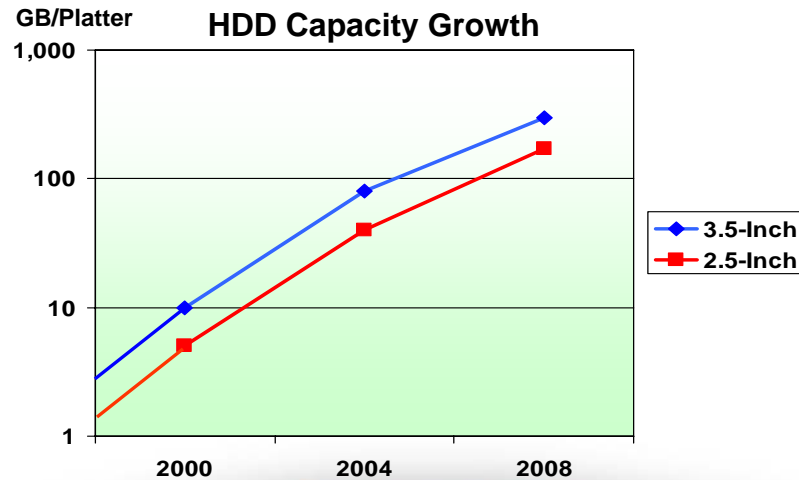


# PC Storage Market Trends



■ Total Notebooks ■ Total Desktops

*Gartner Inc., Dataquest Insight  
Expect PCs to Impact the NAND  
Flash Market after 2008  
by J. Unsworth, 12.15.2006.*

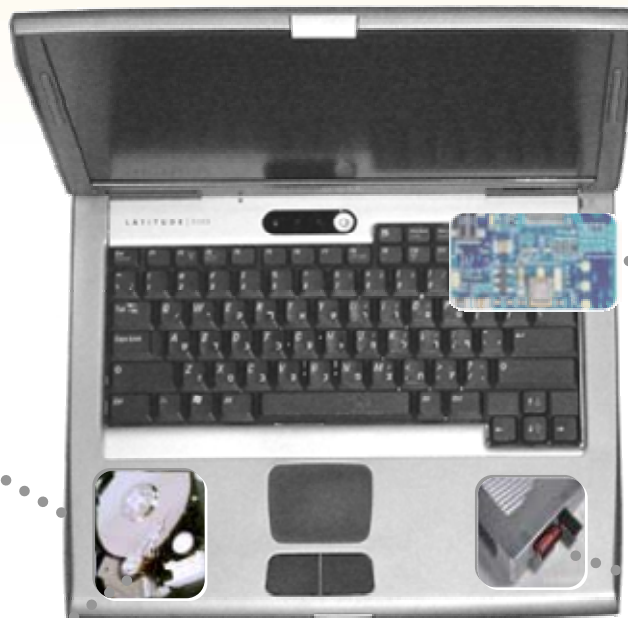


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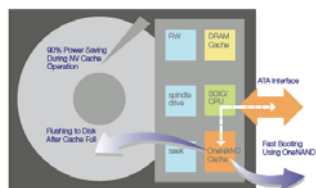
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# NAND Flash in PC Solutions & Challenges



## Hybrid-HDD



### Market Challenges

- ✓ HDD business model
- ✓ Extreme cost sensitivities
- ✓ Long-term reliability

## NV System Cache



### Market Challenges

- ✓ Caching solution only
- ✓ Driver dependent
- ✓ Standardization (NVMHCI)

## Add-on Windows Vista® Performance (ReadyBoost)



### Market Challenges

- ✓ Limited performance gains in newer systems  
Vista PCs shipping with 1-2GB DRAM

## SSD

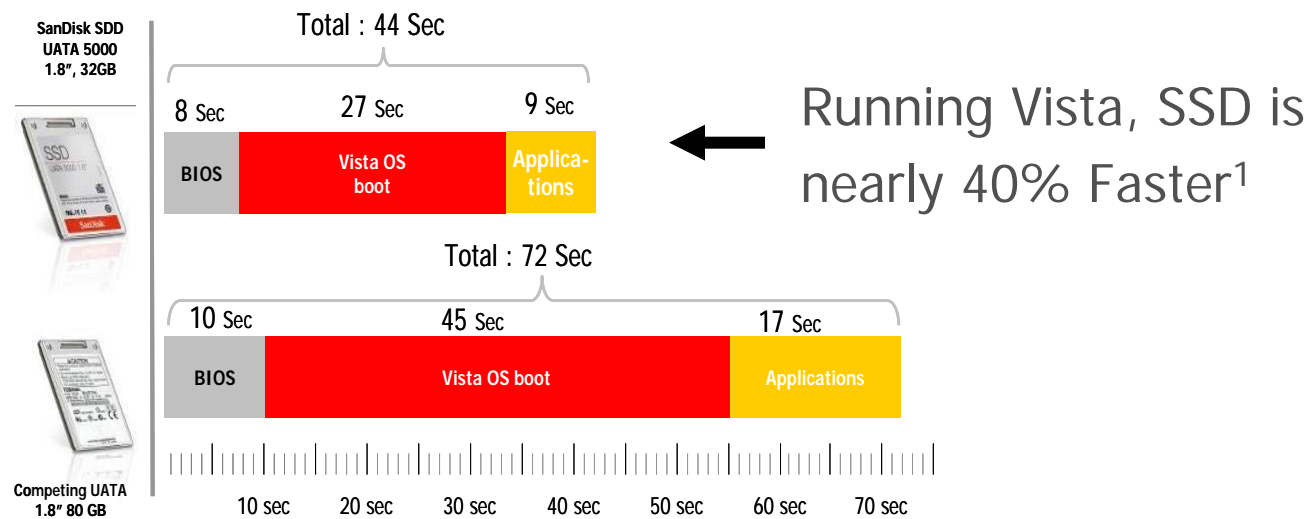


### Market Challenges

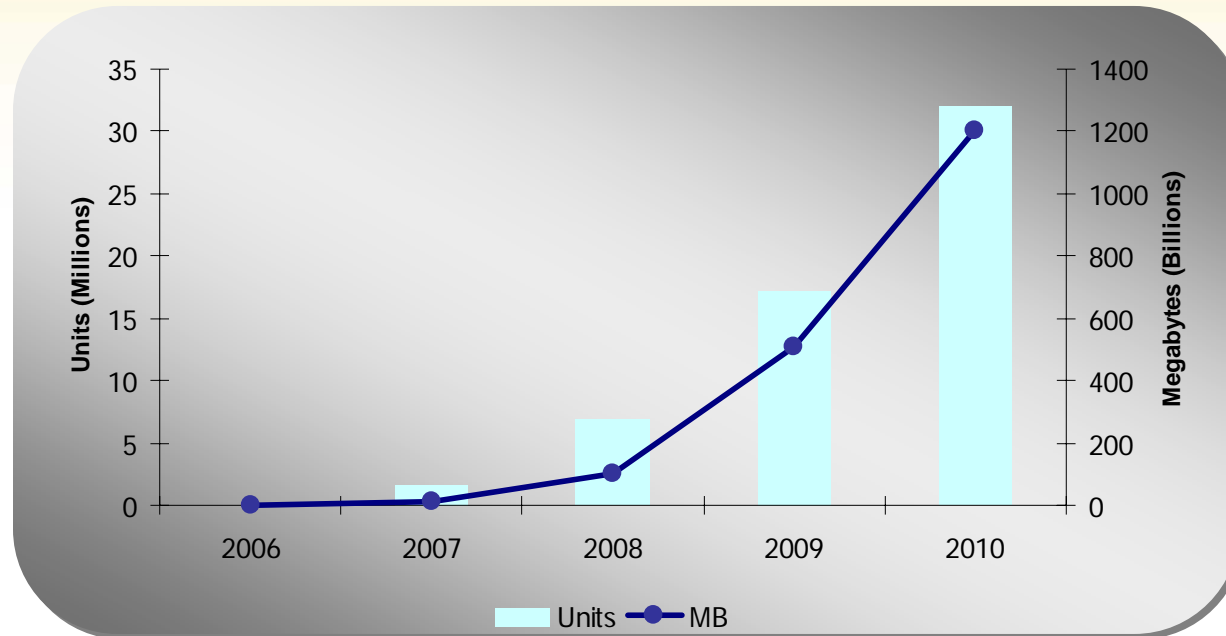
- ✓ Capacity & cost vs. HDD
- ✓ OEM adoption

# SSD Benefits: Improved User Experience

- Less down time and failures = **improved TCO**
- **Faster boot time** and application launch = improved productivity
- **Better performance** → up to 100X faster than Hard Drives (on random searches) Measurably improved productivity and usability
- **Longer battery life** = improved usability



# Projected SSD Penetration in Notebooks by 2010



- SSD penetration in ~20% of the notebook market = **32M units**
- Penetration driven by elasticity and MLC adoption
- 1,200 PB of NAND flash to be used in SSDs or about 11% of NAND output
- TAM >\$3B in 2010 \$100/system ASP

Source: Gartner, May 2007. Notebook market in 2010 is estimated at 153M units.

# Expected 2010 SSD Adoption by Market Segment

	Consumer Laptop				Enterprise Laptop		
	Average User	Student	Mr. Mobility	Geek	Light Traveler	Road Warrior	Executive
Price	Minimal	Minimal	Good	Excellent	Good	Excellent	Excellent
Capacity	Good	Good	Good	Good	Excellent	Excellent	Excellent
Durability	Good	Good	Excellent	Excellent	Excellent	Excellent	Excellent
Performance	Good	Good	Excellent	Excellent	Excellent	Excellent	Excellent
Power efficiency	Good	Good	Excellent	Good	Minimal	Excellent	Excellent
Summary	Minimal	Minimal	Good	Excellent	Good	Excellent	Excellent

- SSD excellent fit
- SSD good fit
- SSD minimal fit

# Concluding Thoughts

- NAND Strength continues across all categories
  - DSC Imaging, Mobile Handset, Audio MP3 Players, UFD, etc..
- Expect falling pricing will drive new markets and applications
  - Professional Video & PC, etc..
- MLC challenges are an opportunity for major players
  - Barriers to entry
  - System-level solutions vs. “Raw NAND”
- Today’s new “hot markets” were not on the RADAR 12-18 month ago
- What’s next ??