

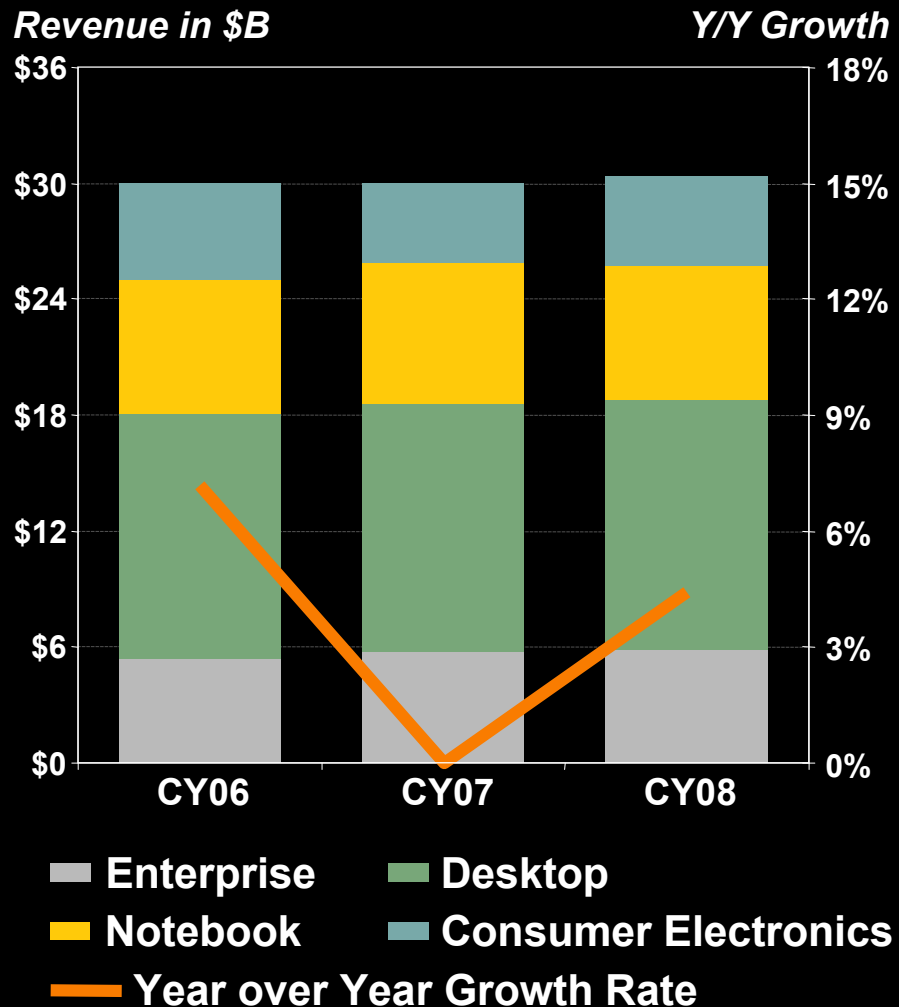


HDD & SSD: Coexistence in a Growing Opportunity

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Executive Director: Market &
Competitive Intelligence



HDD Industry Revenue Outlook

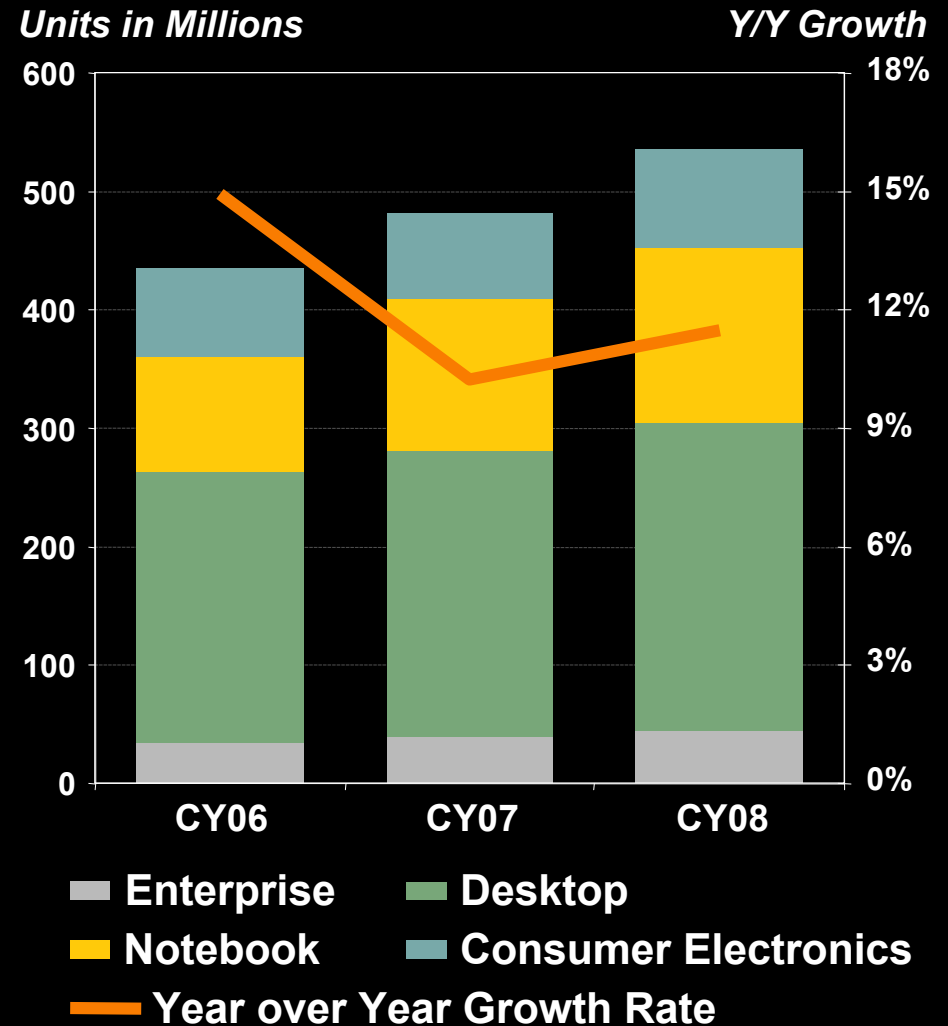


- 2007 revenue will be essentially flat to 2006 at \$30B
- Revenue is expected to increase slightly in 2008
- The notebook market will account with most of the growth in the market

Source: Seagate Market Research

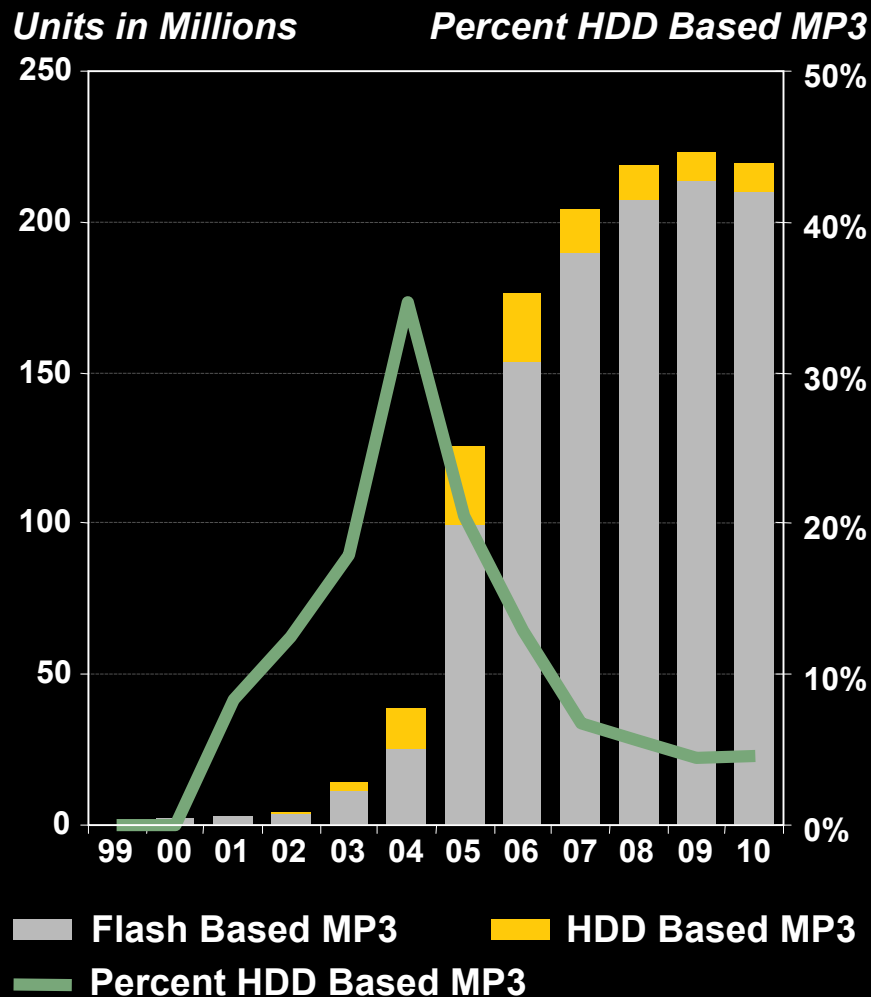
HDD Industry Seeing Good Unit Growth

- Total units grew 15% to 435M in CY06, it will reach 480M units this year
- Aggressive pricing hampering the industry
- CY07 HDD growth rates:
 - Notebooks: 28%
 - Desktop: 7%
 - Mission Critical Enterprise 4%
 - Consumer Electronics: (3%)
- The negative growth in the CE market is due to a declining mobile CE business



Source: Seagate Market Research

Who is Attacking Who?



- It is not a story about replacing disc in MP3 players
 - At one time, all MP3 players were 100% solid state
 - It was the HDD that displaced solid state
- Handheld markets should be flash, yet HDD based MP3 continue to be viable
- The real story, how come flash still can not completely displace the HDD?

Source: STX, IDC, Gartner, GfK, NPD & IMS

Exponential User-Generated Content

- User Generated content sites will generate 65 Billion page views & downloads by 2010
 - This is equivalent to 1.1 Exabytes
 - 47% of all US online video is UG
- YouTube videos take up an estimated 45 TBs of storage
- There are 1 billion digital still & digital phone cameras in the world
 - In 2006 they accounted for 250 billion created images – the equivalent of 120 exabytes
 - The entire HDD industry shipped only 50 exabytes in 2006

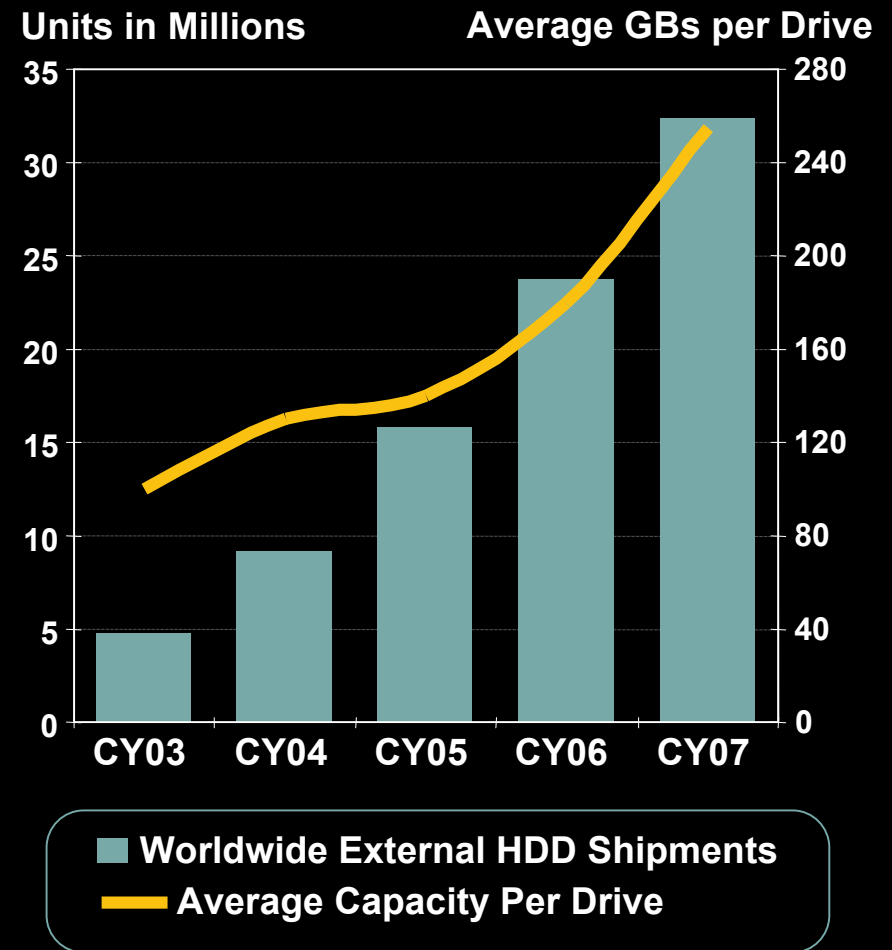


Source: In-Stat, Screen Digest, Parks Associates, WSJ & Seagate Market Research

A Measurable Effect of Content Proliferation

The Market for External Retail Hard Disc Drives – All Form Factors

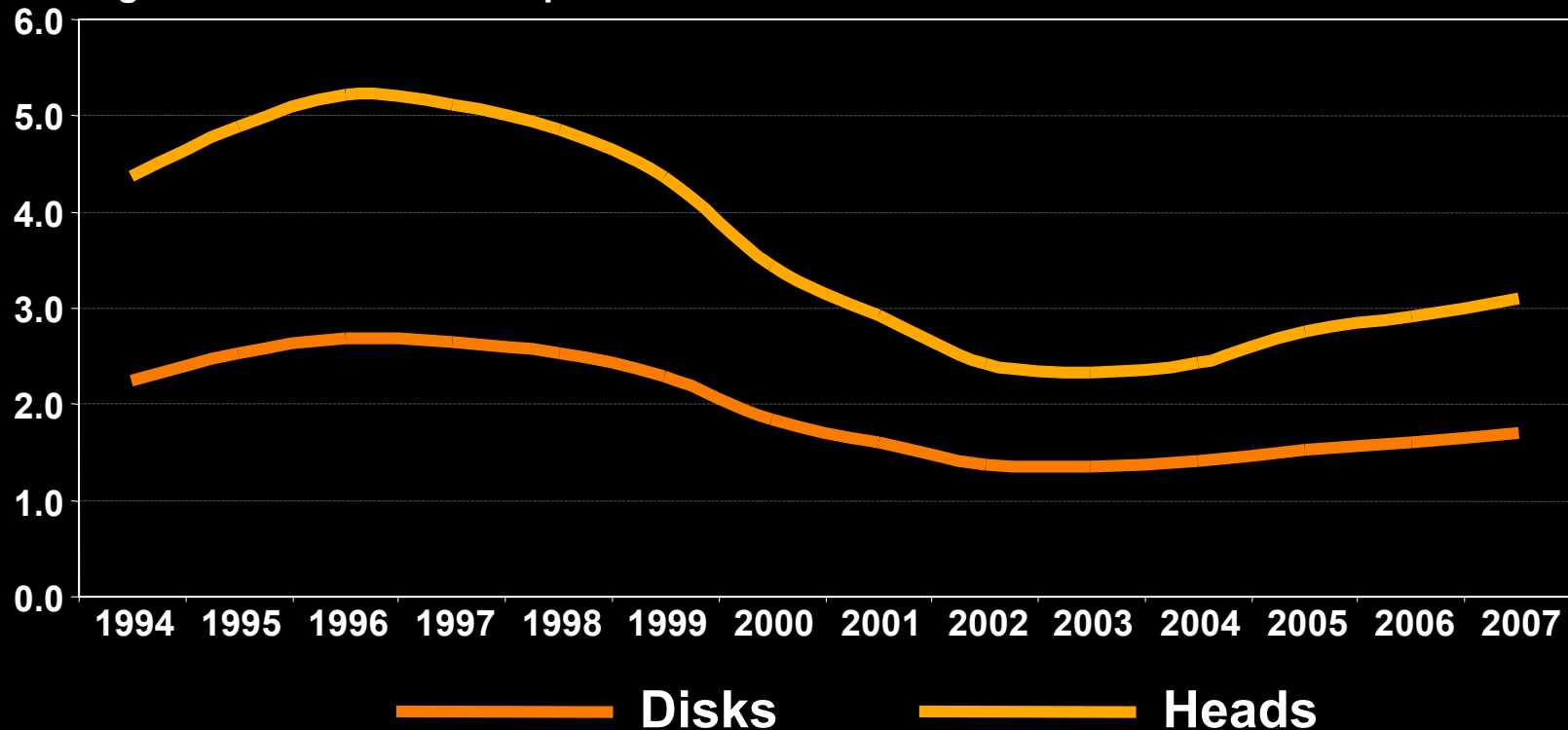
- Shipments of external HDDs have grown at a 65% CAGR since CY03
- The average capacity has reached over 250GB
 - 3X the CY03 average
 - Over 50% more than the capacity of the average HDD
- Demand driven by consumers & the availability of ubiquitous, rich media content



Source: Seagate Market Research

Customers Demanding More Storage

Average Number Disks/Heads per Drive



Present end user purchasing behavior does not argue for the idea that storage is being over-served

Source: Seagate Market Research

Each Technology Has a place in the Market

- **HDD Strengths**
 - Highly reliable, mature, proven technology
 - Cost/GB leader
 - \$30B market and growing
- **Hybrid HDD – Strengths**
 - Leverages proven HDD technology
 - Improves HDD performance, without sacrificing capacity
 - Lowers HDD power by operating from cache for extended periods
 - Extends HDD reliability by spinning down drive while operating from cache
- **SSD Strengths**
 - No moving parts = most rugged storage solution
 - High performance through reduced access latency
 - Die and Package stacking enables small form-factors
 - Lower power than most HDDs

What is the Place SSD in the Compute Space?

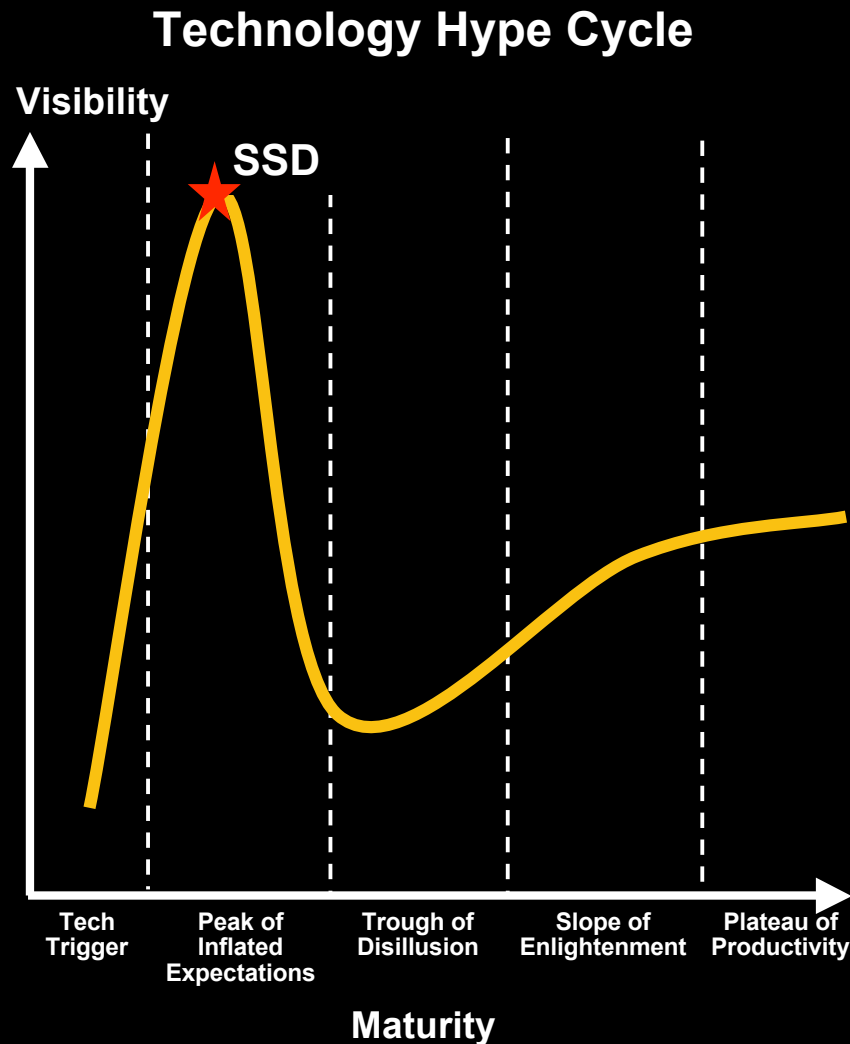
Not question of “if”

**But a question of when,
where & why**

What is the Place SSD in the Compute Space?

**A mass market is likely five
years away**

The Use Case SSDs Still Unknown



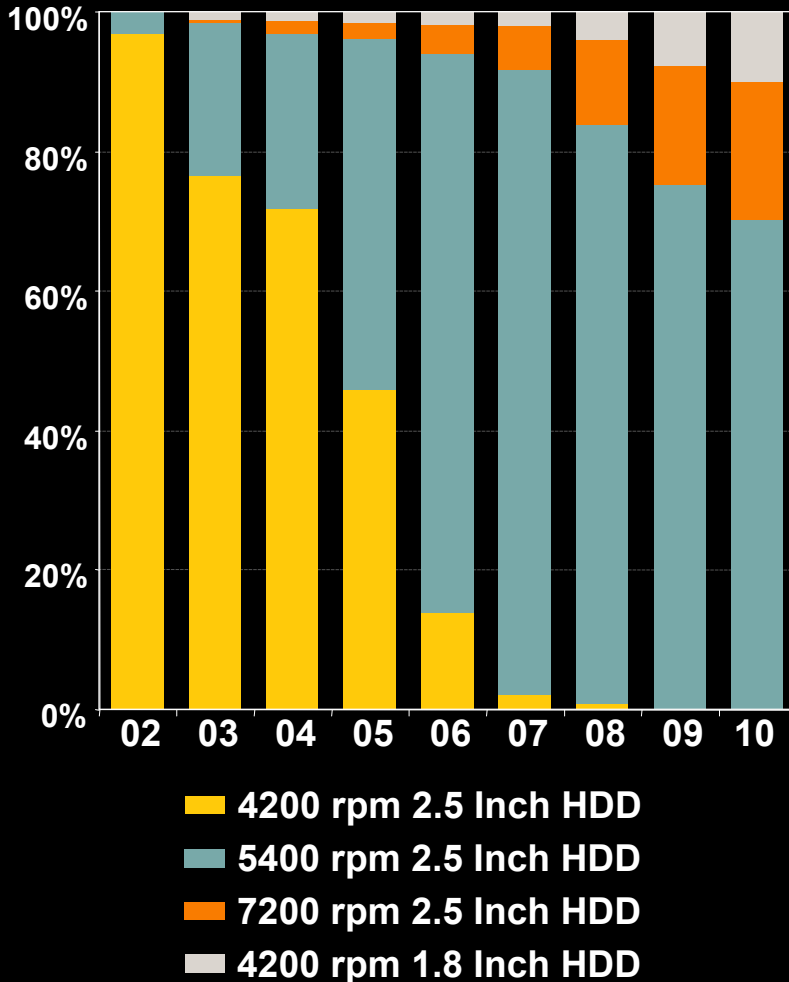
- SSD is at or near the top of the hype cycle
- It will go through the “Trough of Disillusion”
 - The depth of the trough is still to be determined
 - It is about promises made & promises kept
- The economics are well understood
- How consumers will value SSDs is not yet understood

Source: Gartner & Seagate

Observation: Unrealistic Benchmark Comparisons

The Case of the Notebook HDD Market

Percent of Market

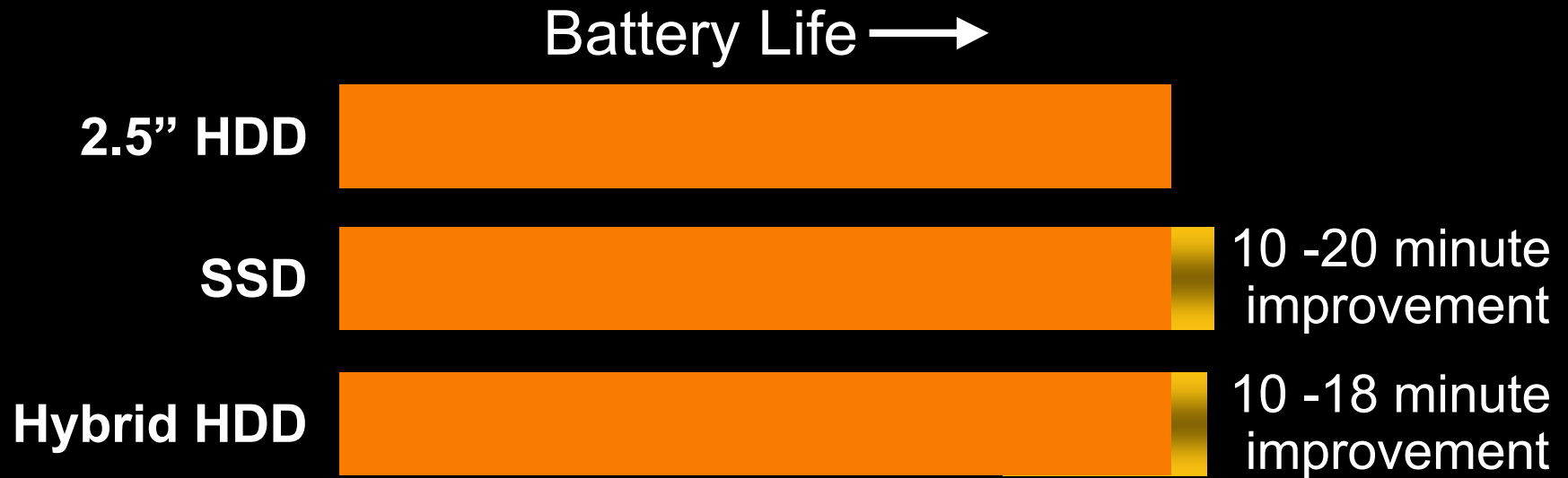


- The notebook industry is a 5400 rpm 2.5 inch HDD market
 - The move to 7200 rpm begins in in CY08
 - Small form factor yet to take off
- 2.5 inch drives set the performance benchmark
- SSDs targeted at 1.8 inch applications is a niche play

Source: Seagate Market Research

Observation: Meaningless War of Words

The Battery Life Example



How much value will consumers put on such a small incremental gain?
Further, if they care why not go hybrid?

Source: Seagate Longmont Testing

Observation: Real Performance not Discussed

Benchmark	32GB SSD	160GB 2.5" HDD
Mobile Mark Battery Life	328 minutes	PATA 328 min SATA 316 min
PC Mark 04	8415 +143%	3460
Sustained Sequential Reads	50MB/s	59MB/S +18%
Sustained Sequential Writes	29MB/s	52MB/S +79%
Random Reads (8kB)	2450 IOPS +3500%	70 IOPS
Random Writes (8kB)	24 IOPS	116 IOPS +487%
Random Reads & Writes (OLTP 8KB 1Q, 80%R, 20%W)	79 IOPS	79 IOPS

The actual performance difference the user sees will depend on the use pattern

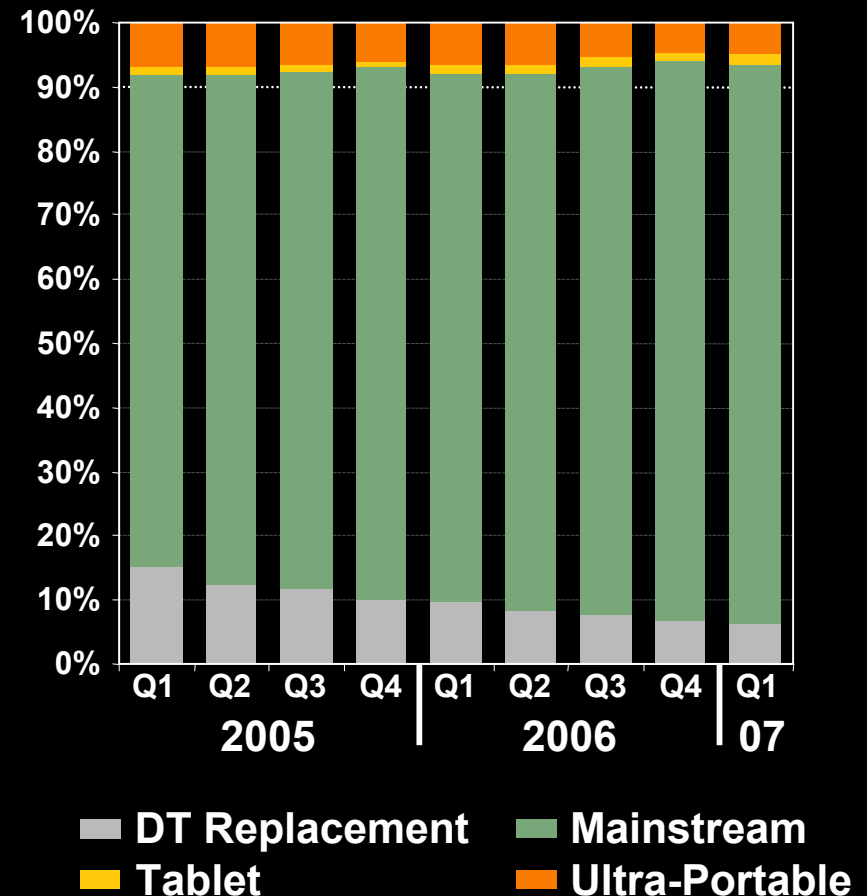
Source: Seagate Longmont Testing

Observation: Notebooks are not Changing

Notebook Market by Form Factor

- To date, ultra-portable notebooks have not been a growth market
- Suggests that physical size of monitor & keyboard are important
- A mass storage devices is not likely to significantly changes these dynamics

Percent of Market

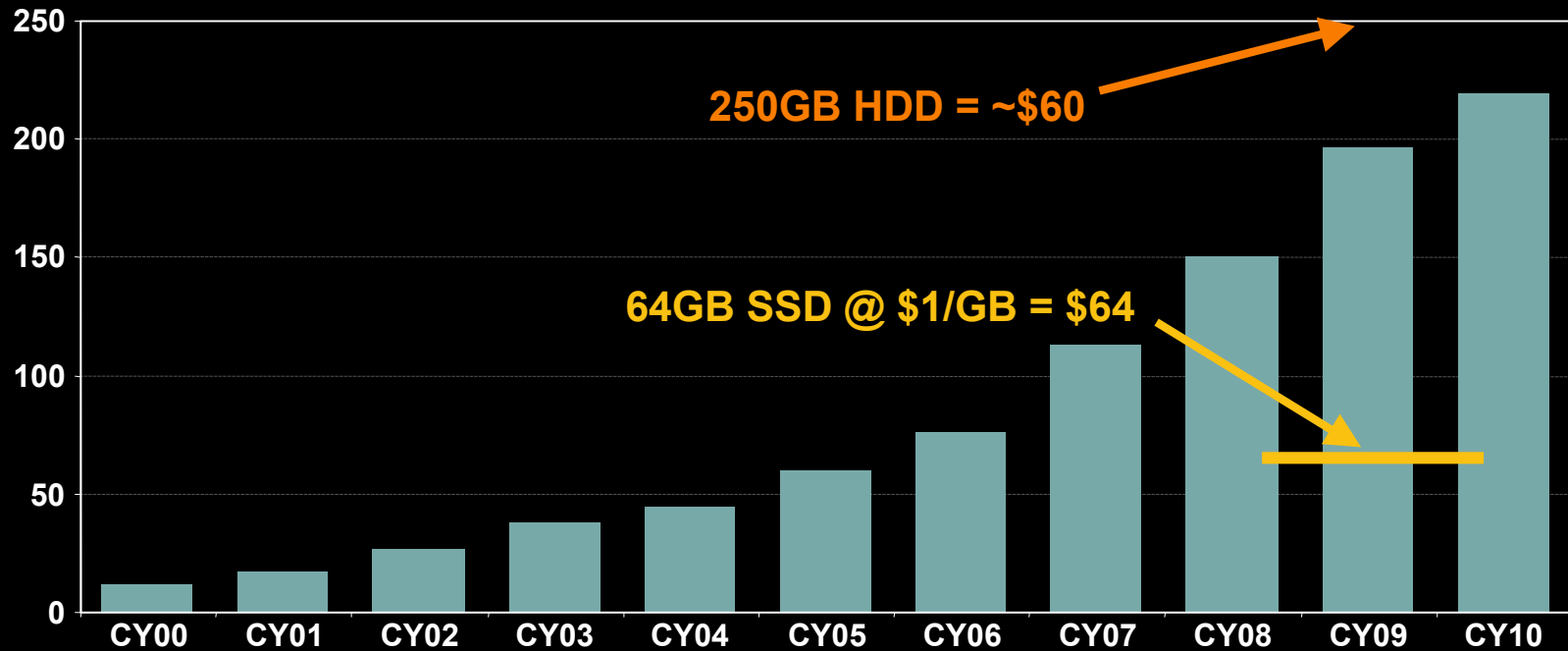


Source: Gartner & Seagate

Observation: Capacity Does Matter

Average HDD Capacity for a Notebook Hard Disc Drive

Capacity in GBs



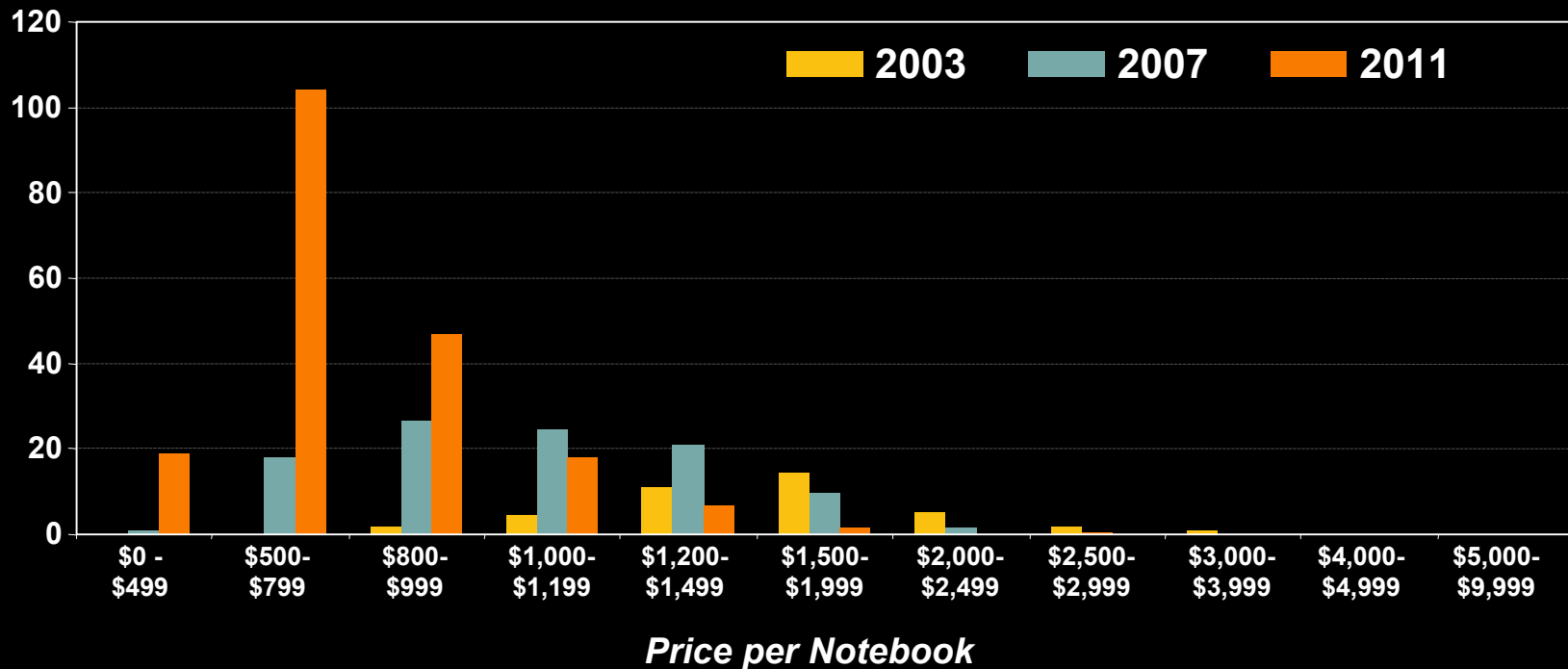
Large capacity cited as important in Gartner end user surveys. Further, paying more for less capacity is not a common end user behavior

Source: Seagate Market Research & Gartner

Observation: Budgets Do Come Into Play

Average Price of Notebook Computer

Millions of Units



Notebook prices expected to fall 30% by 2011 arguing lower component prices will be necessary

Source: Gartner & Seagate Market Research

Observation: Little Real Data to Compare

CMU Paper on HDD Reliability in Enterprise Environments*

COM1	
<u>Component</u>	<u>%</u>

- * Hardware failures/replacements by type

Source: CMU Computer Science Dept

Observation: Little Real Data to Compare

CMU Paper on HDD Reliability in Enterprise Environments*

COM1	
<u>Component</u>	<u>%</u>
Power supply	34.8

- * **Hardware failures/replacements by type**

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Observation: Little Real Data to Compare

CMU Paper on HDD Reliability in Enterprise Environments*

COM1	
<i>Component</i>	<i>%</i>
Power supply	34.8
Memory	20.1

• * Hardware failures/replacements by type

Source: CMU Computer Science Dept

Observation: Little Real Data to Compare

CMU Paper on HDD Reliability in Enterprise Environments*

COM1	
<u>Component</u>	<u>%</u>
Power supply	34.8
Memory	20.1
Hard drive	18.1
Case	11.4
Fan	8.0
CPU	2.0
SCSI Board	0.6
NIC Card	1.2
LV Power Board	0.6
CPU heatsink	0.6

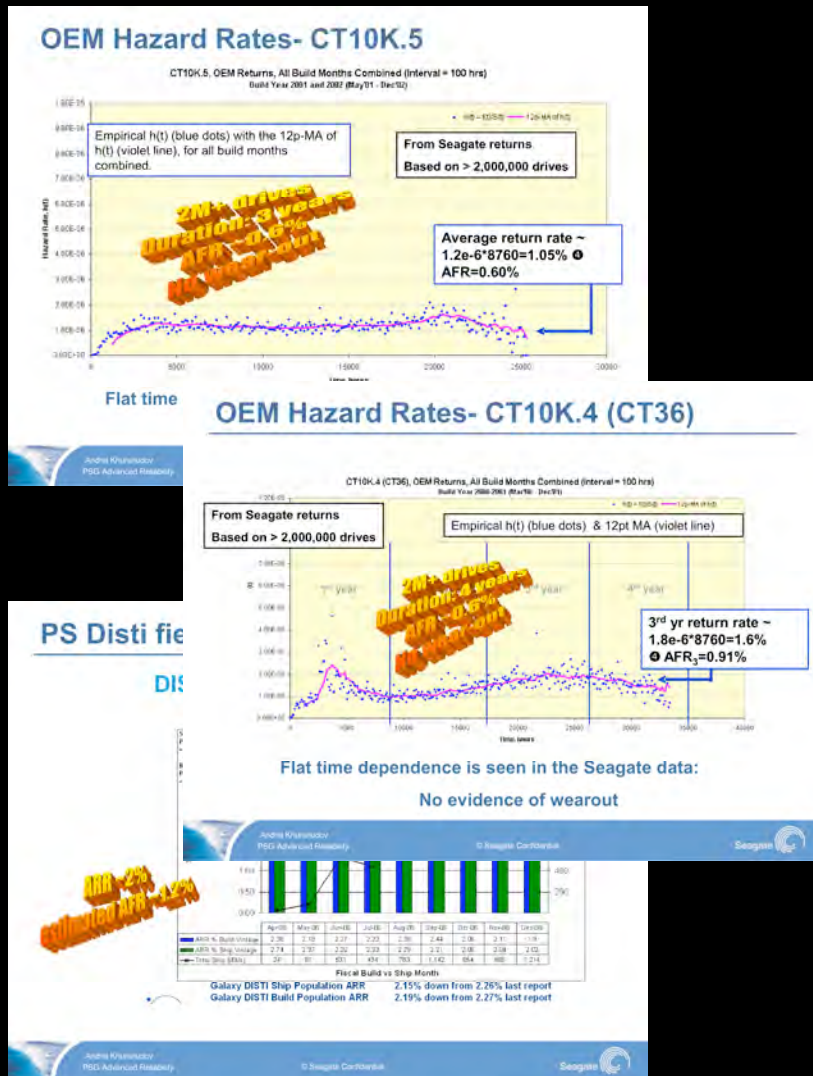
HPC1	
<u>Component</u>	<u>%</u>
Hard drive	30.6
Memory	28.5
Misc/Unk	14.4
CPU	12.4
PCI motherboard	4.9
Controller	2.9
QSW	1.7
Power supply	1.6
MLB	1.0
SCSI BP	0.3

- Customers only care about their own experience
- The HDD industry has embedded 3 billion HDDs into compute environments
- Compares to a small installed base of SSDs in niche applications

* Hardware failures/replacements by type

Source: CMU Computer Science Dept & Seagate Market Research

Real Data Needed for Comparison



- Returns & failures are two different things
 - “No trouble found” accounts for about half the returns
 - When in doubt replace the device – its under warranty
- STX sample of two million drives indicates AFRs are within spec
- Data from the solid state industry would likely refute the high failure rates of memory in the CMU study

Source: Seagate Longmont Testing

Observation: PR Doesn't Matter, Real Events Do

CMU Paper: Data on Node Outages

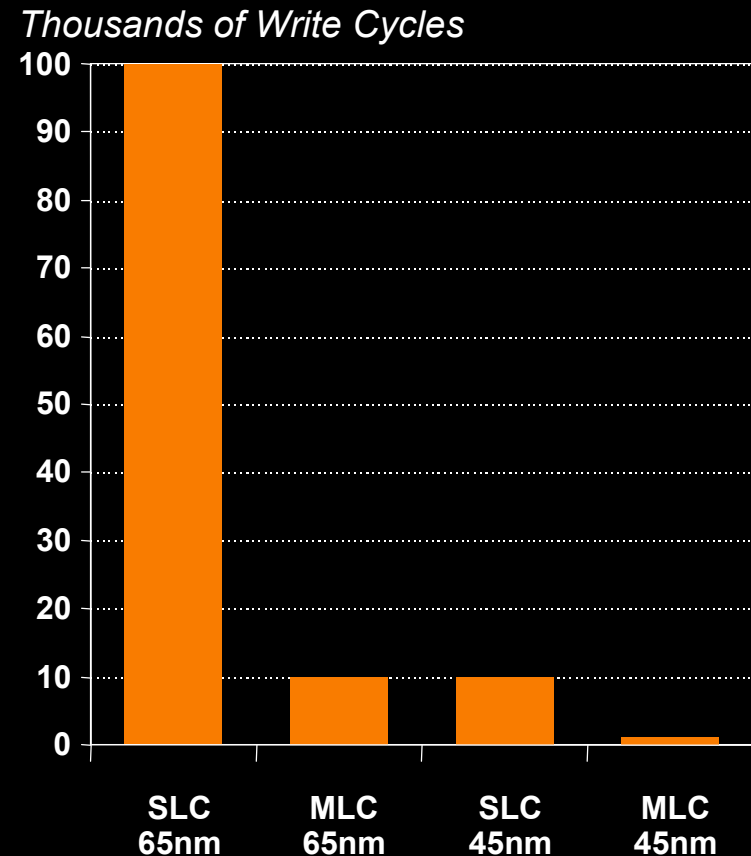
HPC1	
<u>Component</u>	<u>%</u>
CPU	44
Memory	29
Hard drive	16
PCI motherboard	9
Power supply	2

The CMU study on hardware reliability indicates that solid state memory is 80% more likely to create a node outage than a hard disc drive.

Source: CMU Computer Science Dept

Other Issues Facing SSD to Consider

- Write cycle integrity issues needs to be addressed
- Different cost models for implementing technology
 - HDD costs are incremental to increase capacity & volume
 - Billions needed to bring on the next SSD technology
- Technology hurdles still formidable
- 50% per year price declines needed



Source: Micron, Toshiba & Samsung

Further: OEMs Likely to Remain Agnostic

	<u>Moving From</u>	<u>To</u>	<u>Added Price</u>
<u>Desktop</u>			
Dell	160GB	320GB	\$75
Dell	160GB	500GB	\$195
HP	250GB	500GB	\$210
HP	250GB	750GB	\$280
<u>Notebook</u>			
Dell	80GB	160GB	\$93
Dell	80GB	250GB	\$232
HP	80GB	160GB	\$50
HP	80GB	200GB	\$125

- OEMs will support both technologies
 - Will let the customer decide
 - Can not openly support one over the other
- HDD manufacturer's ability to stack heads & discs is key
 - Provides an up-sell opportunity
 - Excellent margin business
- Need to be able to offer high capacity solutions

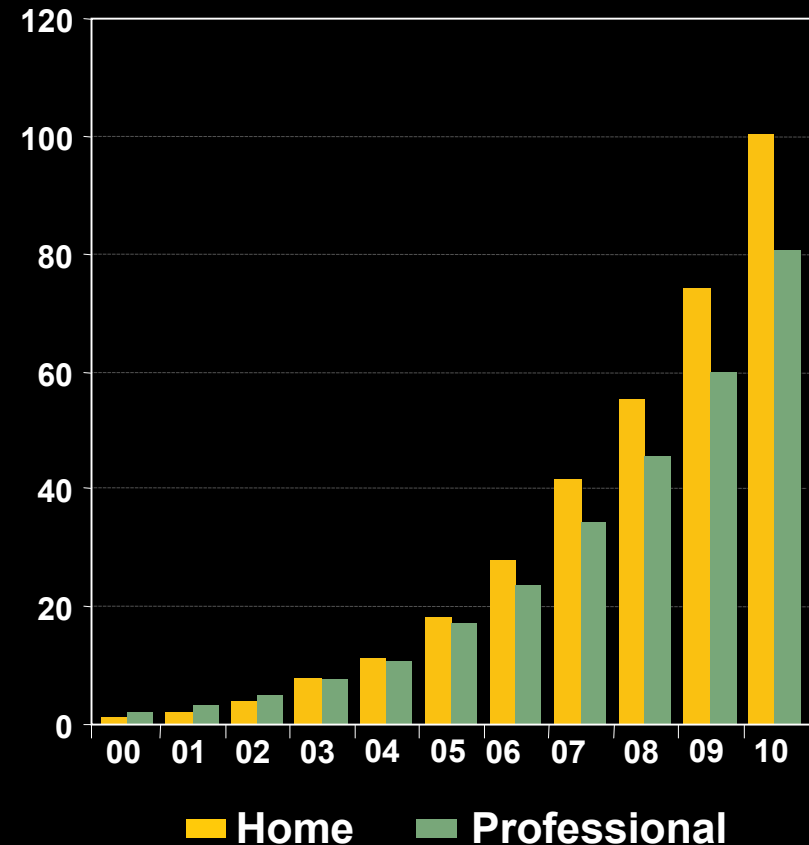
Source: HPQ & Dell websites 7/23/07

Consumers Will Drive the Market in 2012

The Home has Surpassed the Professional in Storage Consumption

- They are looking for more than the latest technology
 - Looking project an attitude
 - Fulfill the need to participation & be part of a community
- Employees will change how they interact with their firm
 - Home bandwidth & computing power will exceed that provided by the office
 - Do not want to be dictated to by corporate IT
- IT department assumptions about technology scarcity & uniqueness breaking down

Exabytes Consumed



Source: Seagate Market Research

Technology Part of the Social Fabric

- Consumers view technology as fashion
 - Statement of their identity
 - Looking for “cool” experiences
 - Design becoming key driver
- Virtualized communities are enabled by technology
 - Supports new ways for people to collaborate
 - Provide additional methods for distributing information
- The ability to create content & distribute it quickly
- Technology self-sufficient



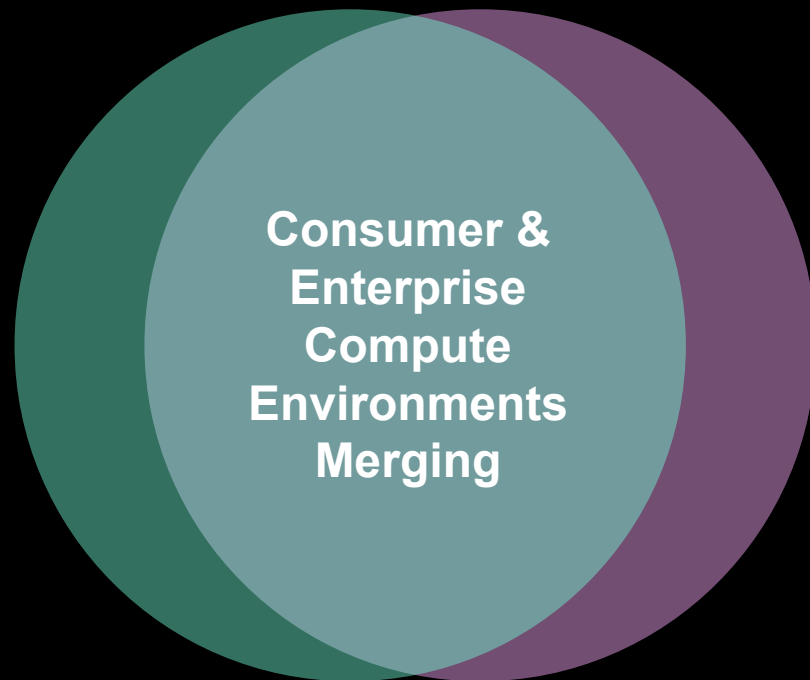
Source: Seagate Market Research

How Does it Shake Out?

By 2012 more than 80% of enterprises will permit the use of effective consumer IT solutions

Source: Gartner

A changing IT Landscape

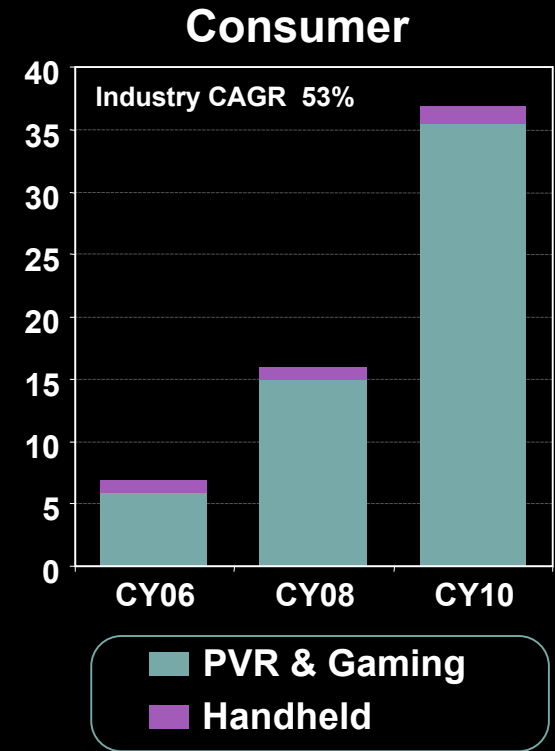
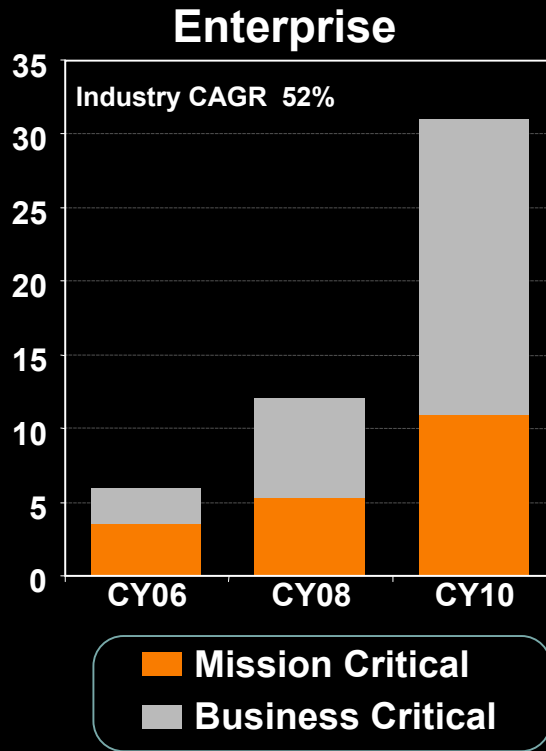
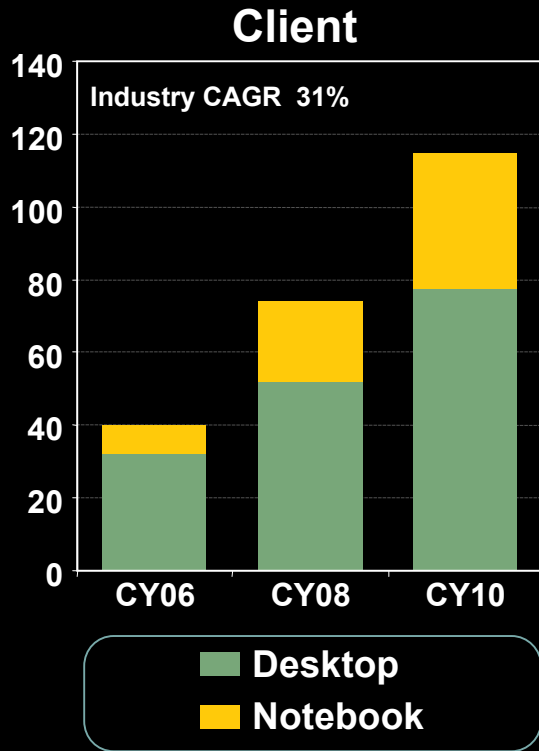


- IT maintain control of core systems
 - Must deal with the regulatory & compliance issues
 - Shift cost of maintaining the desktop environment to the user
- The user acquires new freedoms
 - Choice of devices & personal productivity tools
 - The ability to use collaborative environments
 - Take on new responsibilities for support, security, backup etc

Source: Seagate Market Research

Drives Content Proliferation

Hard Disc Drive Exabytes Shipped by Segment

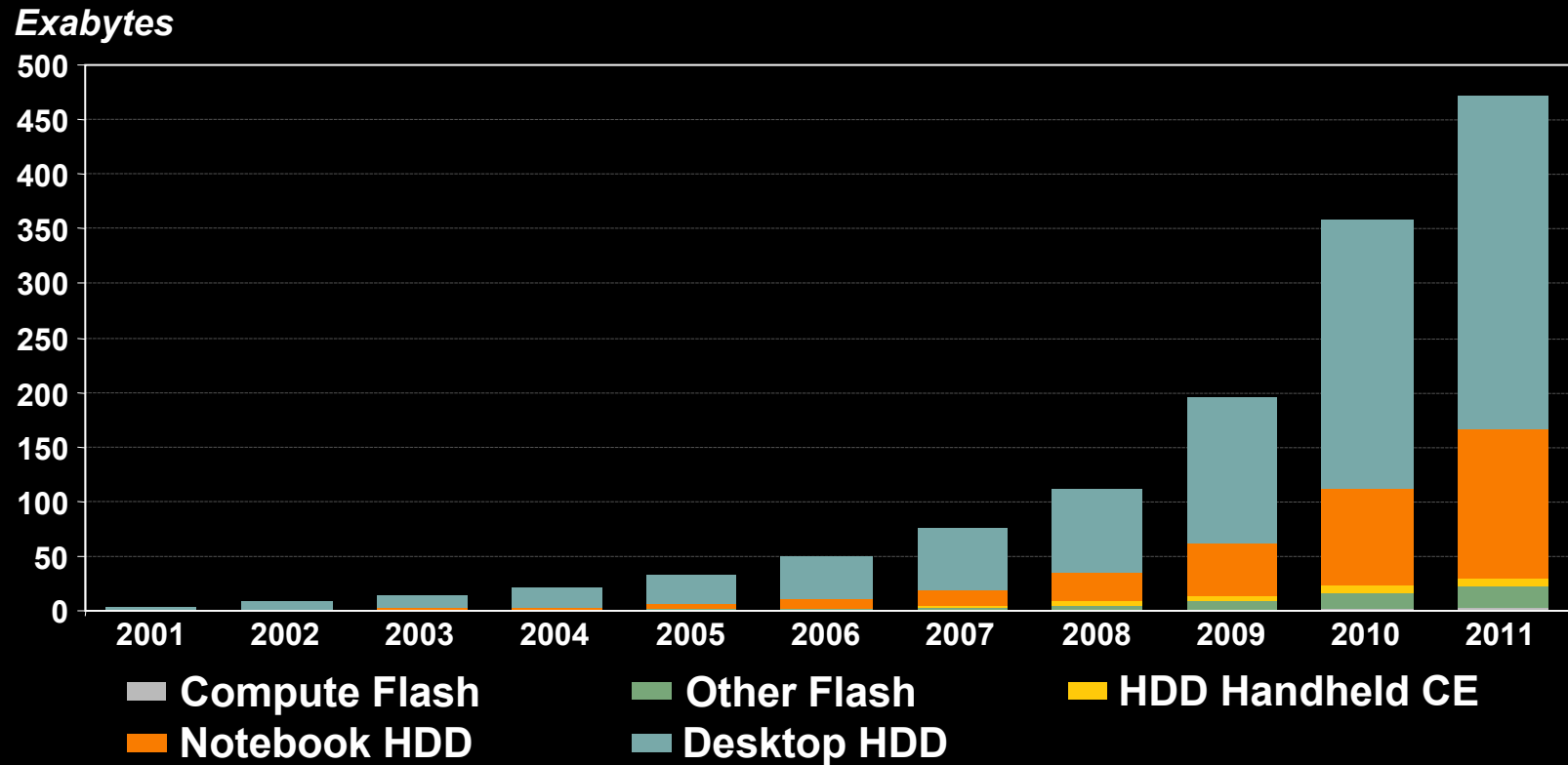


**Capacity shipped to continue grow at ~40% annually
Leads to a potential \$42B market in CY10**

Source: Seagate Market Research

Hard Drives Continue to be Storage of Choice

Gartner Forecast for Capacity Shipments by Technology



Gartner expects 95% of the Exabytes shipped to be HDD based in CY11

Source: Gartner

Mass Market versus a Niche

For Compute Environments



- Flash making in-roads into niche applications
 - Entry capacity applications that favor mobility
 - Rugged computers, ultra-portables & enterprise boot drives
- Promises must be kept to achieve a mass market
 - An installed base needed
 - Must consider hybrid a competitor
- Mass market also enable at “good enough” capacity at a low cost
 - “Good enough” is a moving target
 - Think 80GB SSD at \$25

Source: Seagate Market Research

SSD or HDD... It's Really Quite Simple

The Promise for Notebook

- Lighter
- Lower Power
- More Rugged
- Faster

And Hybrid Promises...

- 5g more weight
- Lower Power
- *Maybe?*
- Faster

The customer Premium...

- @ 32GB = \$500
- @ 64GB = \$1200

At Premium.... (<\$100)

How big is the market for a product that's 60% below market average capacity and weighs 5g less for \$500 more in price?

HDD & SSD will Coexist



- Continued proliferation of digital content is good for all of us
- This is a mutually beneficial relationship
 - Consumers demand content on their handheld devices
 - These handheld devices are “tethered” to PC HDD & massive content servers
- This relationship is driving an ever higher demand for all storage

Source: Seagate Market Research

Thank You

Source: Seagate Market Research

Flash Summit 2007
August 2007

Confidential

35





HDD & SSD: Coexistence in a Growing Opportunity

Jeff Burke
Executive Director: Market &
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