



# NAND Continues to Soar (App after App after App...)

Jim Elliott  
VP Memory Marketing  
Samsung Semiconductor, Inc.  
August 12, 2009

# Agenda

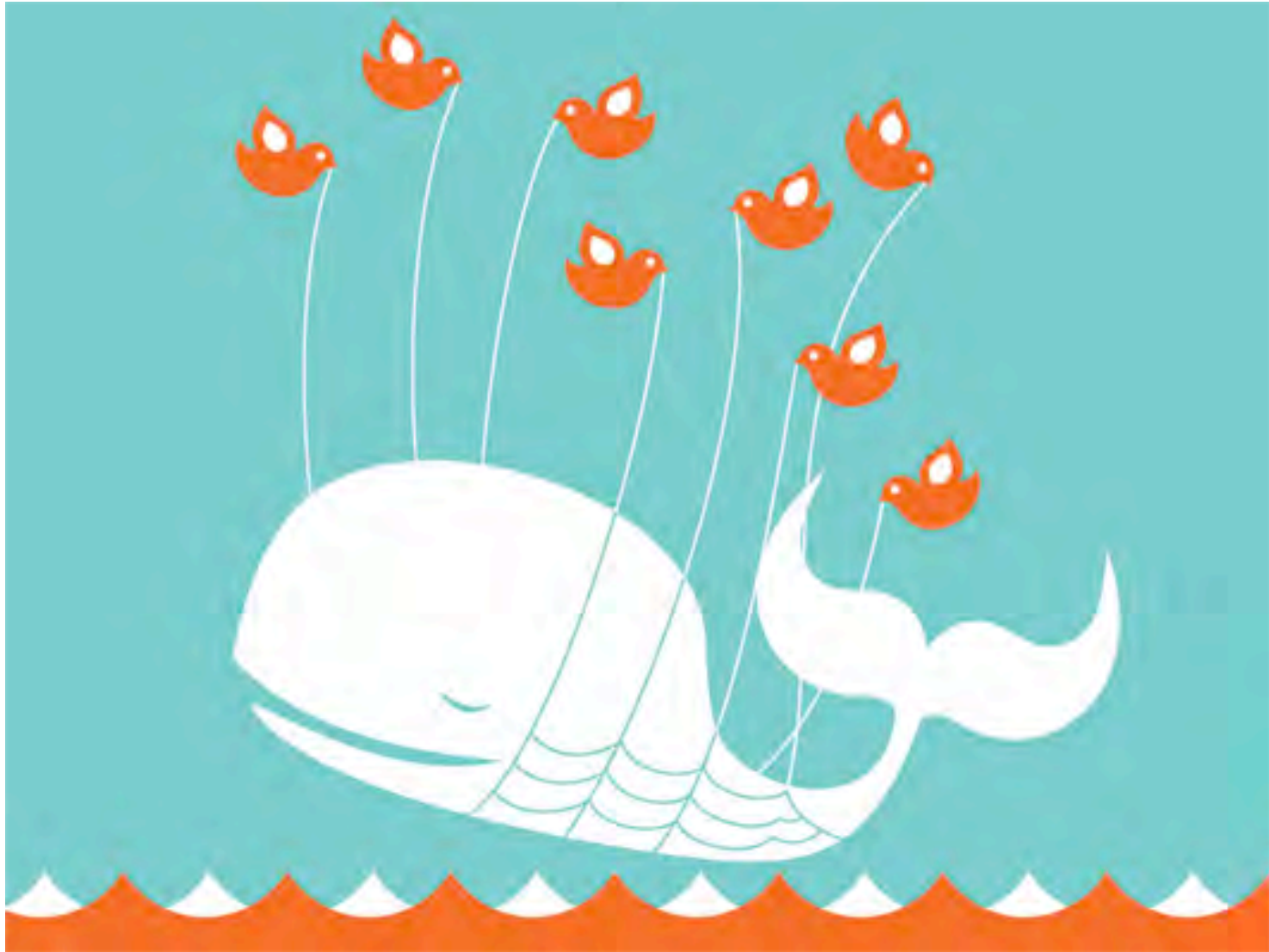
- Pop Quiz
- Memory Market Overview
- NAND Market Update
  - ❖ Application Trends
  - ❖ New Killer Applications
- Green Story
- Closing Comments

# Agenda

- ❑ Pop Quiz 
- ❑ Memory Market Overview
- ❑ NAND Market Update
  - ❖ Application Trends
  - ❖ New Killer Applications
- ❑ Green Story
- ❑ Closing Comments

# What is This Image?

# What is This Image?



# What is This Image?



**Newly Iconic “Fail Whale”**  
Appears when Twitter is Overloaded...

# Flash Memory Summit “Tweet”

twitter

[Home](#) [Profile](#) [Find People](#) [Settings](#) [Help](#) [Sign out](#)

What are you doing?

140

**I Just Gave Away a 256GB SSD at FMS!**

Latest: Check out my Keynote Speech at Flash Memory Summit tomorrow at 2PM. There might be a 256GB SSD in it for yo... less than 5 seconds ago

update



Jimelliott70

37

[following](#)

42

[followers](#)

11

[tweets](#)

**We Follow**

n. a directory of interesting Twitter accounts.



Wednesday, August 12, 2009

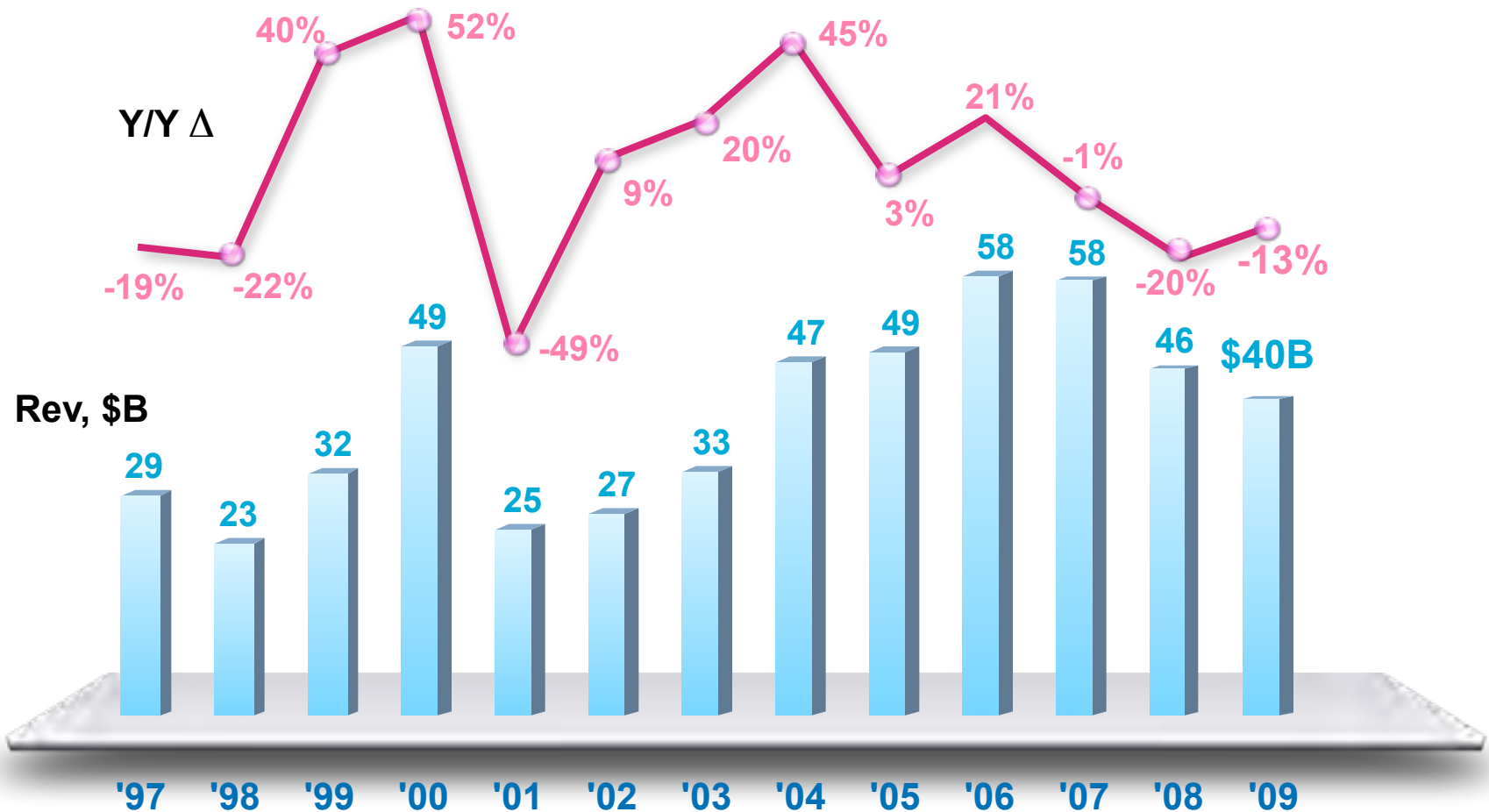
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# 2009 Memory Market Forecast

- ❑ Vectorsing Towards a ~13% Reduction in 2009
  - ❖ 2001: 49% Reduction
  - ❖ 3<sup>rd</sup> Year of Sequential Decline, Despite Continuous Bit Growth



\* Source : WSTS

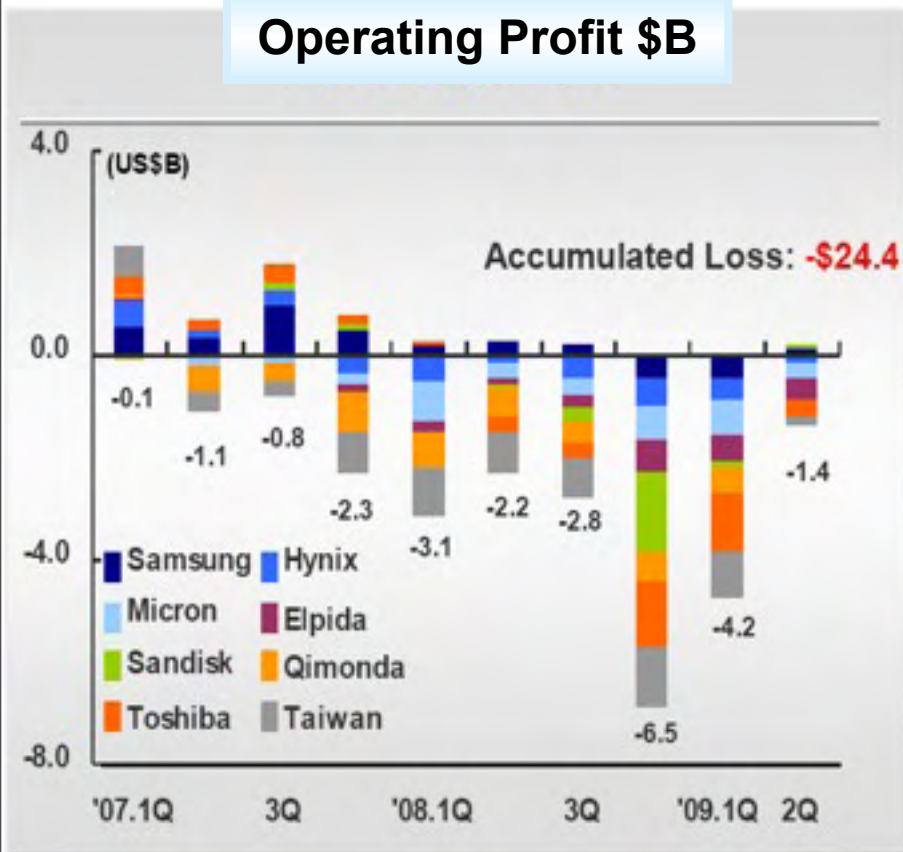


# Memory Vendor Profit History



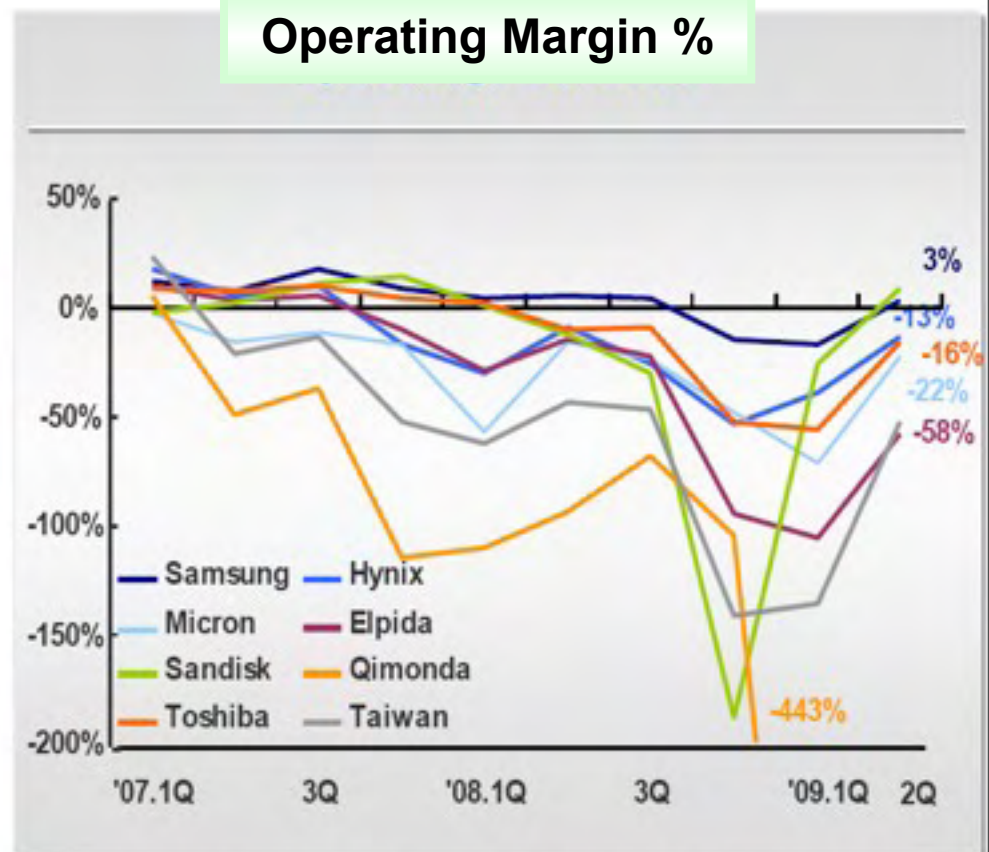
\$24.4B Aggregate Losses Since Q2 '07 → Not Sustainable

Operating Profit \$B



\* OP Figures including Toshiba non-memory & excluding Samsung

Operating Margin %

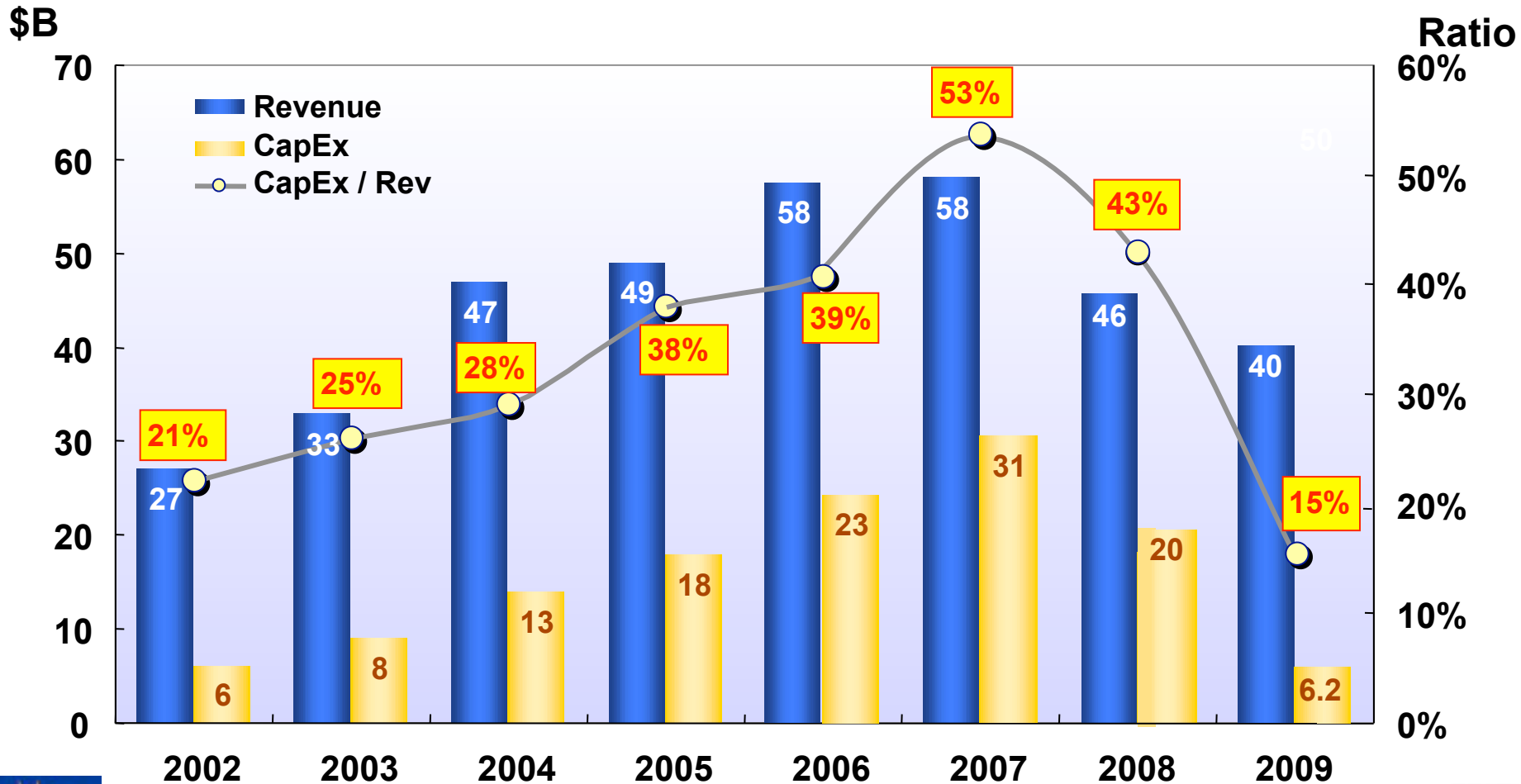


\* Source: Company Reports, PSC & Qimonda: BNP Paribas (Apr 2009)



# Memory CAPEX vs. Revenue Trends

- ❑ **\$51B** Invested in '07 & '08, with an ROI of **-\$24.4B**
- ❑ CAPEX / Revenue Ratio Peaks in 2007 at 53%
  - ❖ Drops to Historic Low of 15% in 2009...



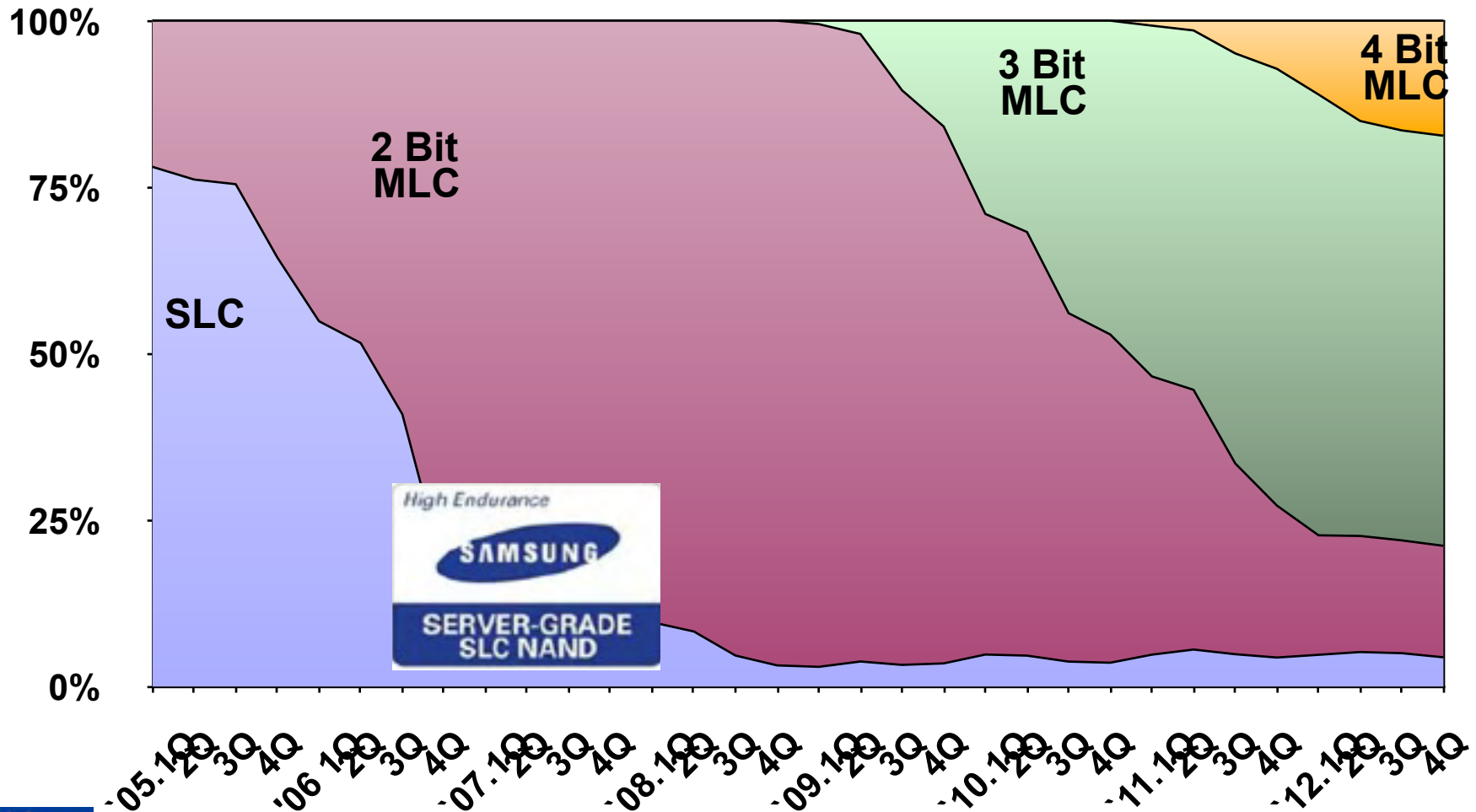
\* Source : WSTS, IDC, Company Reports, SEC Marketing

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# W/W NAND Production Transition

Products Trending Towards Multi-bit MLC  
Also Focusing on High Endurance for Enterprise

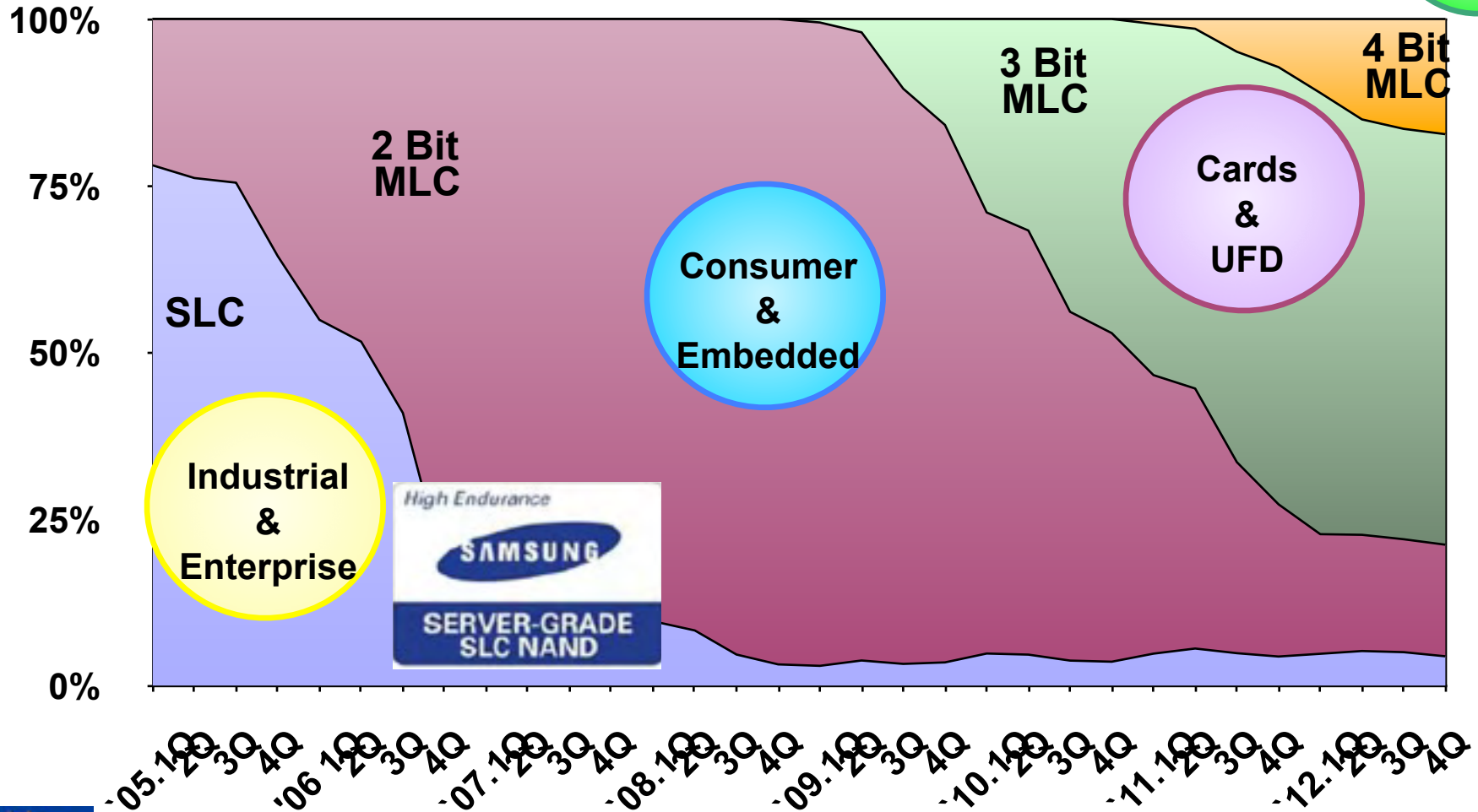


(Source: SEC Jun 2009)



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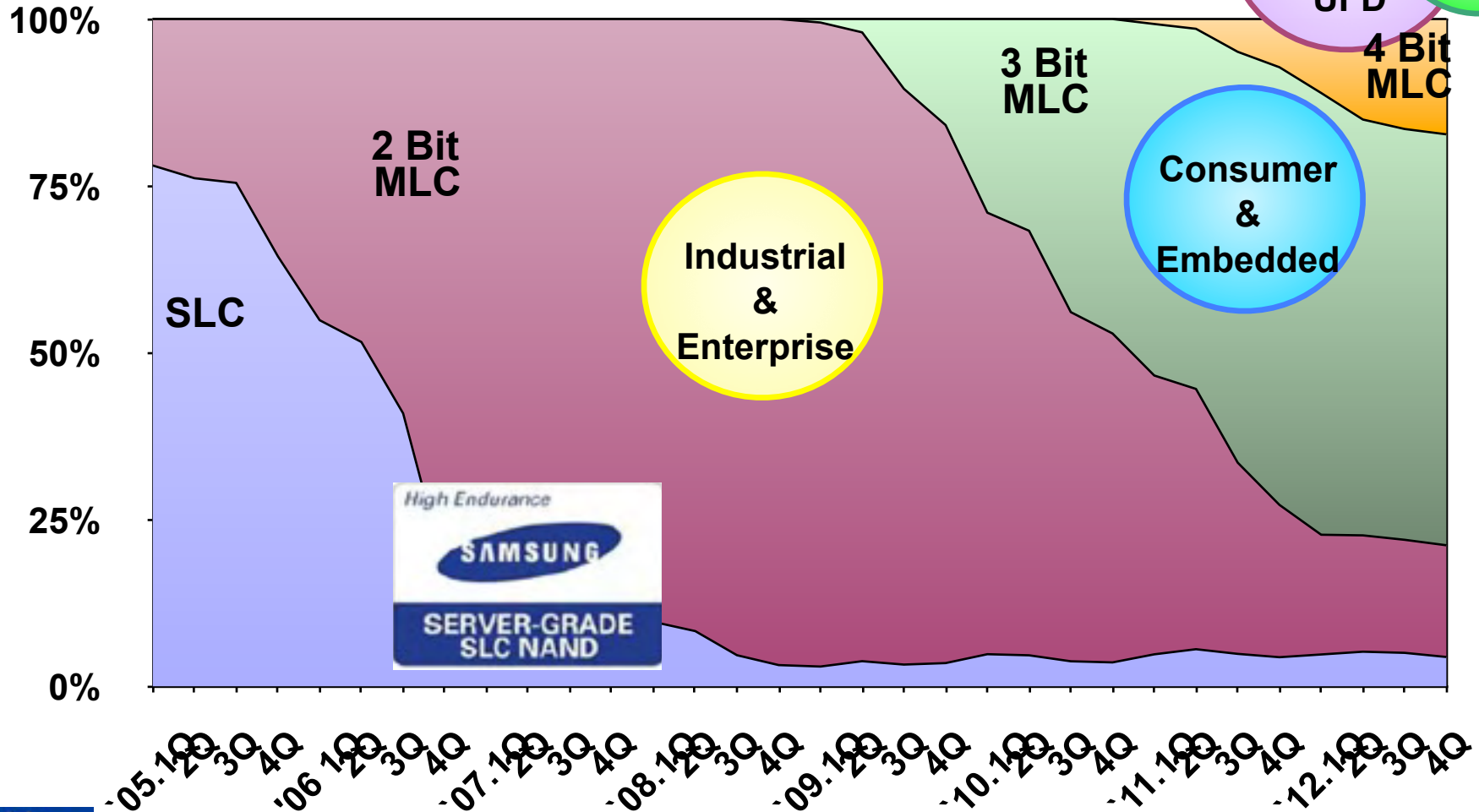


(Source: SEC Jun 2009)



# W/W NAND Production Transition

Products Trending Towards Multi-bit MLC  
Also Focusing on High Endurance for Enterprise



Cards & UFD  
Content

Industrial & Enterprise

Consumer & Embedded



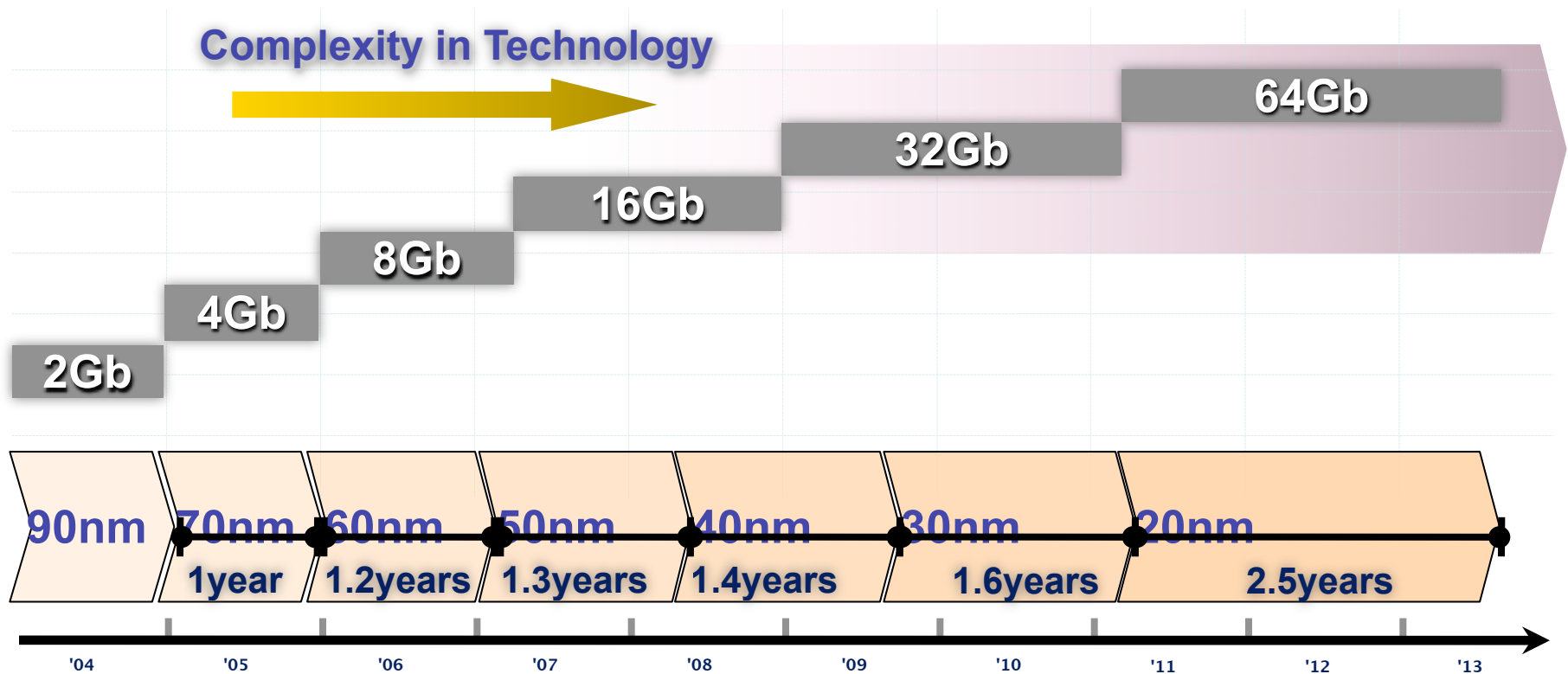
(Source: SEC Jun 2009)





# Prolonged Density Life Cycle

- ❑ Bit Growth Impacted Due to Delays in Process Migration
- ❑ Production-Driven Cost Reductions Will Slow

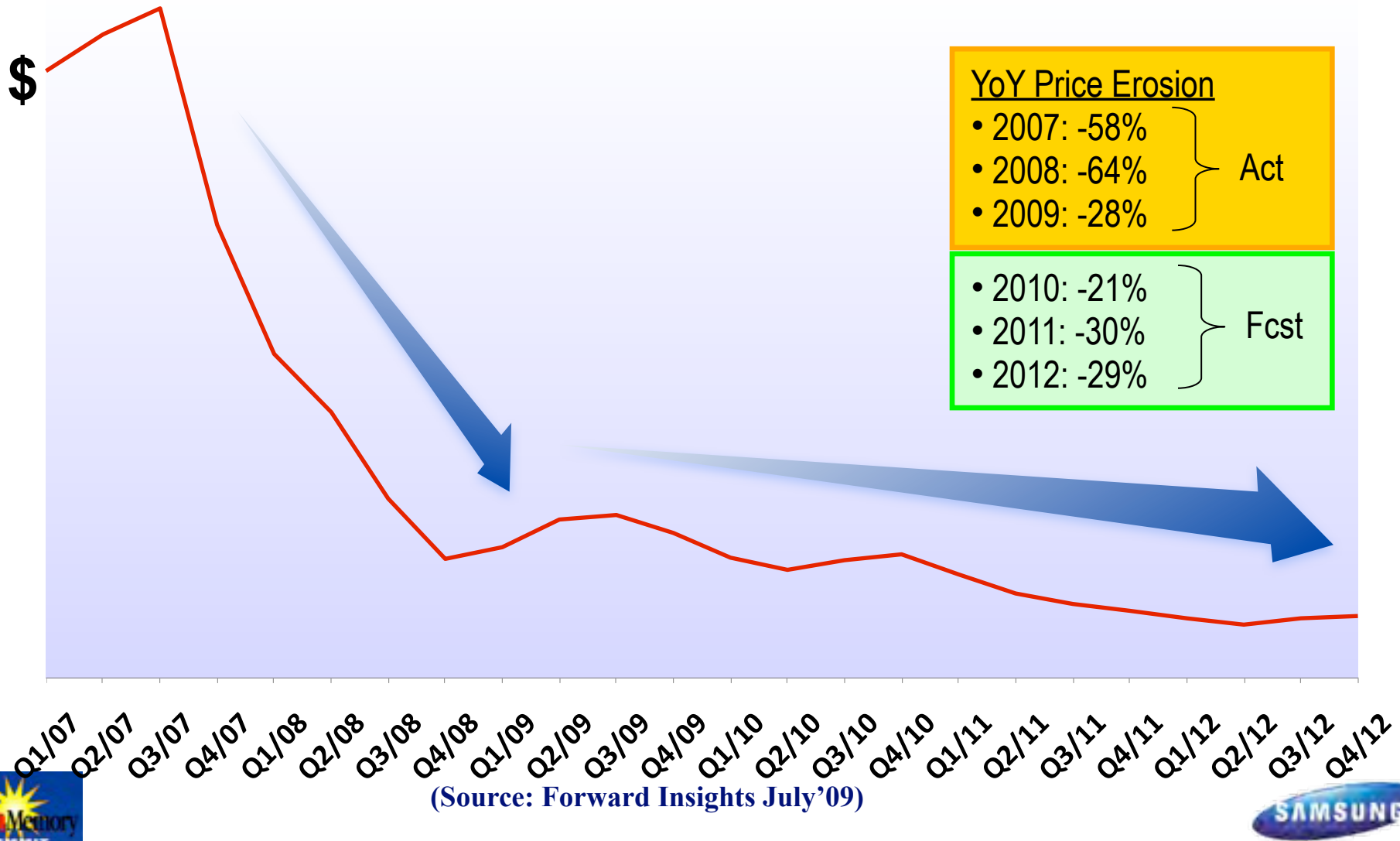


( Source: SEC Jun 2009 )



# Pricing Forecast: Less Volatility?

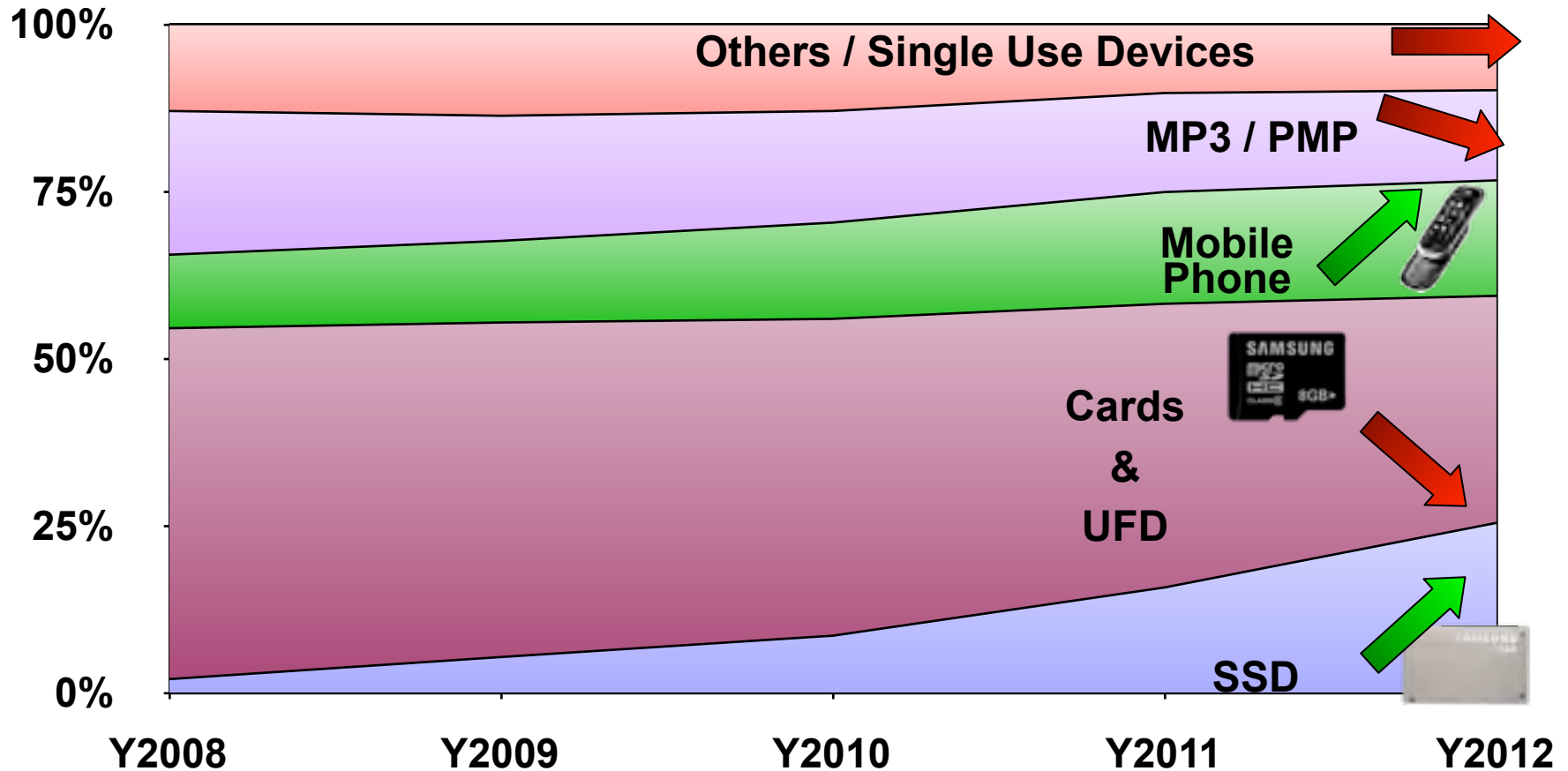
Lower CAPEX Coupled with Longer Migrations → Slower Price Erosion?  
Non Volatile Memory with Less Volatile Pricing?



# NAND Application Trends

Mobile and SSD Categories are Driving Growth...  
Different Demand Patterns / Seasonality Temper Volatility

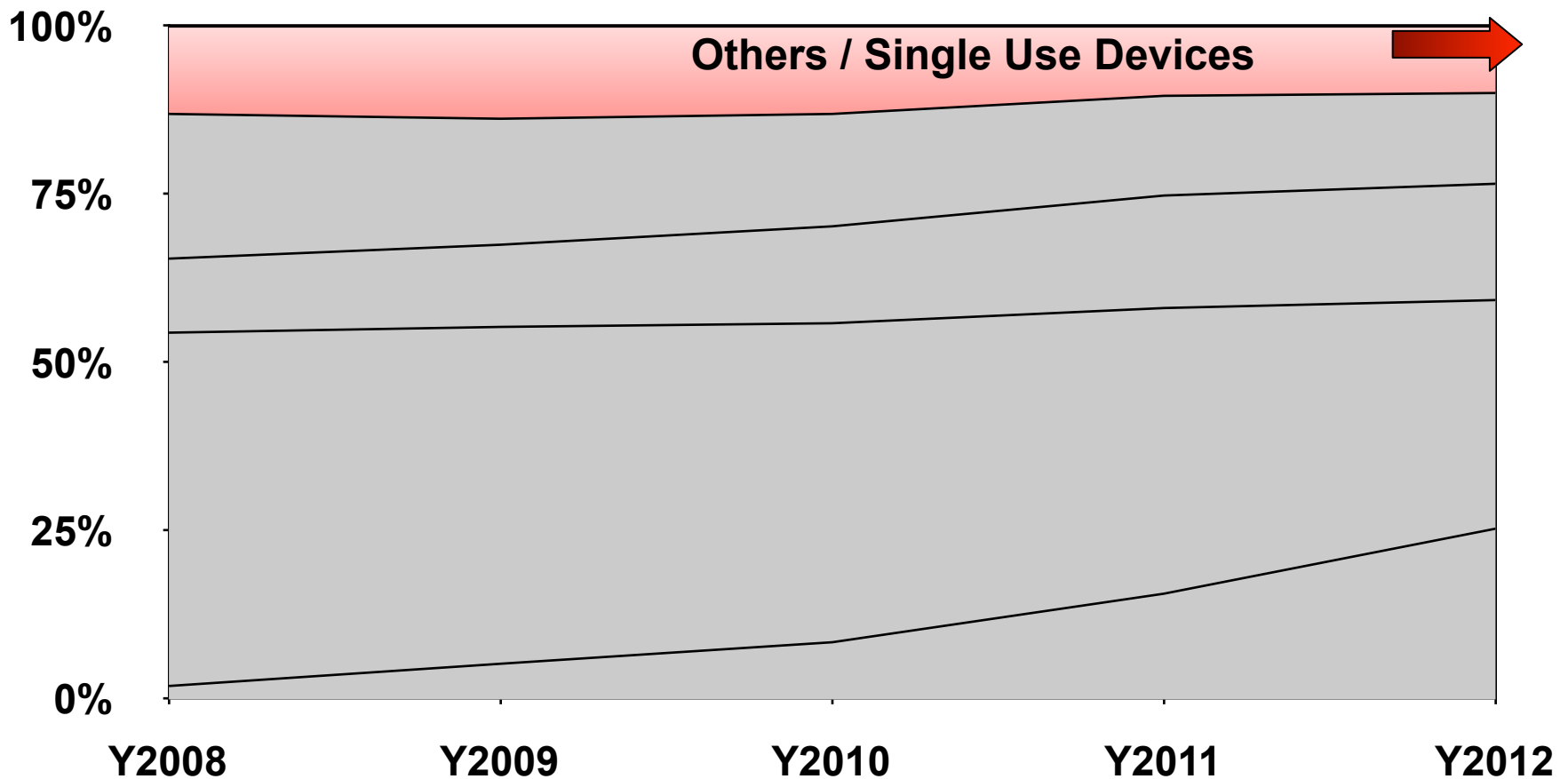
NAND GB Distribution



(Source: SEC Jun 2009)

# NAND Application Trends

Single Use vs Convergent Devices? The Debate Continues...  
Single Use Proliferation Drives NAND Consumption

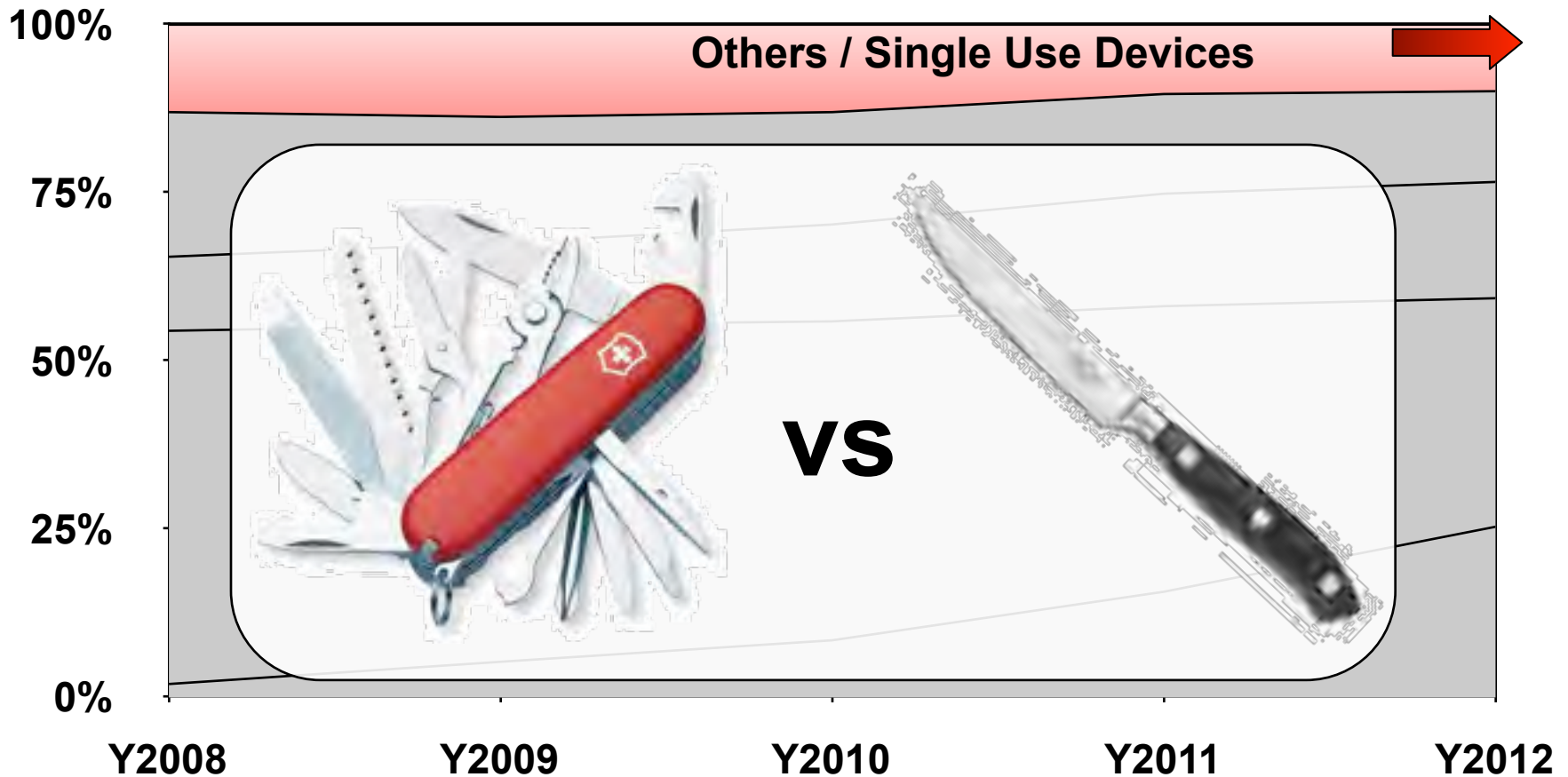


(Source: SEC Jun 2009)



# NAND Application Trends

Single Use vs Convergent Devices? The Debate Continues...  
Single Use Proliferation Drives NAND Consumption



(Source: SEC Jun 2009)

# Flip Video



- ❑ #1 Selling Camcorder in USA
- ❑ New Category for the Camcorder Industry
- ❑ Up to 8GB Embedded NAND Storage
- ❑ Cisco Purchased for **\$590M!**

"Much of the strength of the Flip comes from its simplicity and dedicated purpose."

-- Ross Rubin, NPD group



# Amazon Kindle

- ❑ #1 Book Reader WW
- ❑ Many Competitive Models Launching
- ❑ 2GB and 4GB Embedded Storage Today

Analysts claim many consumers still prefer electronics dedicated to one task.

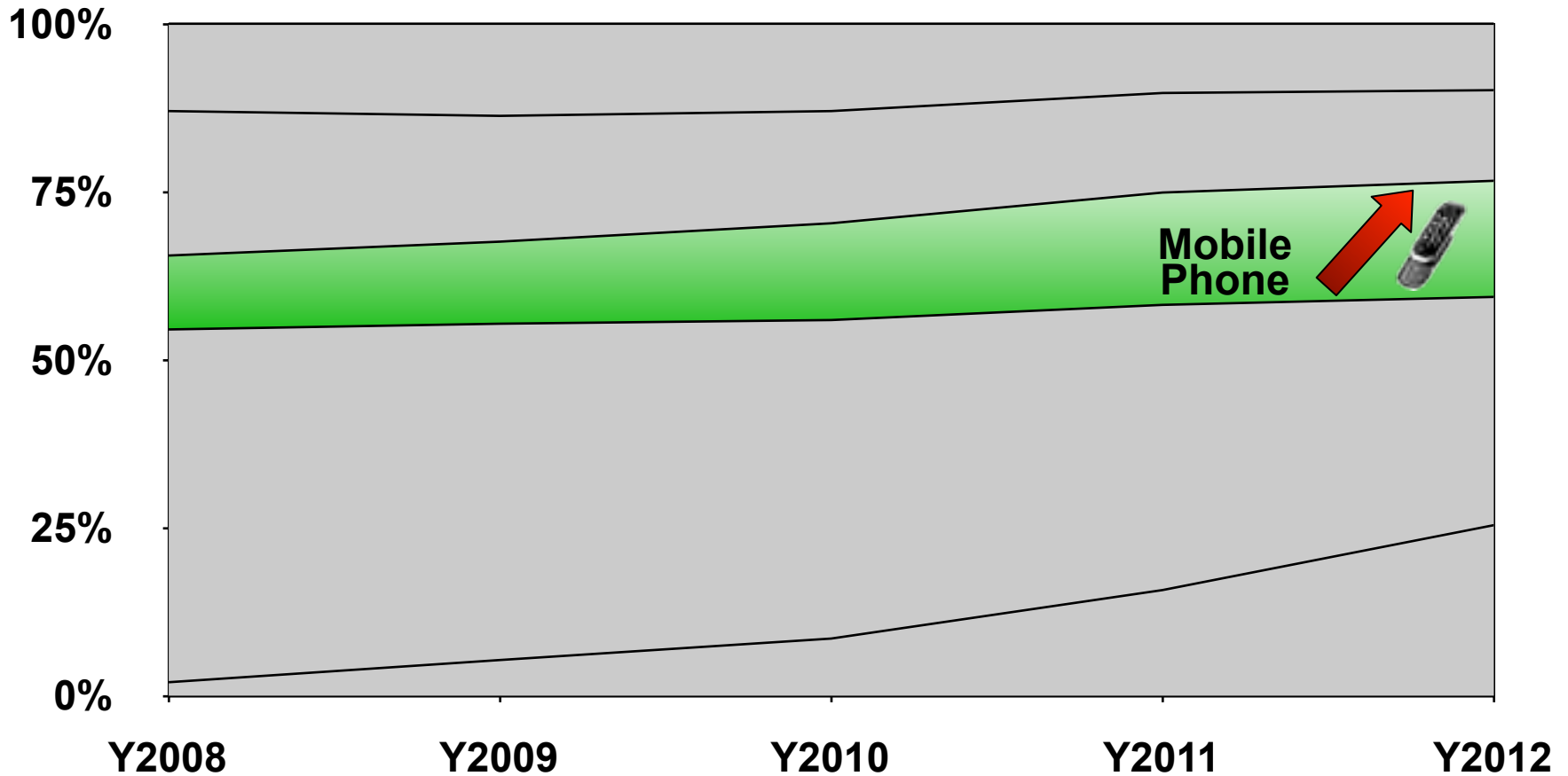
"The consumer doesn't say to themselves, 'I'm going to buy one device that does everything okay.'"

-- Chris Chute, IDC



# NAND Application Trends

## Mobile Phones are Holding Their Own

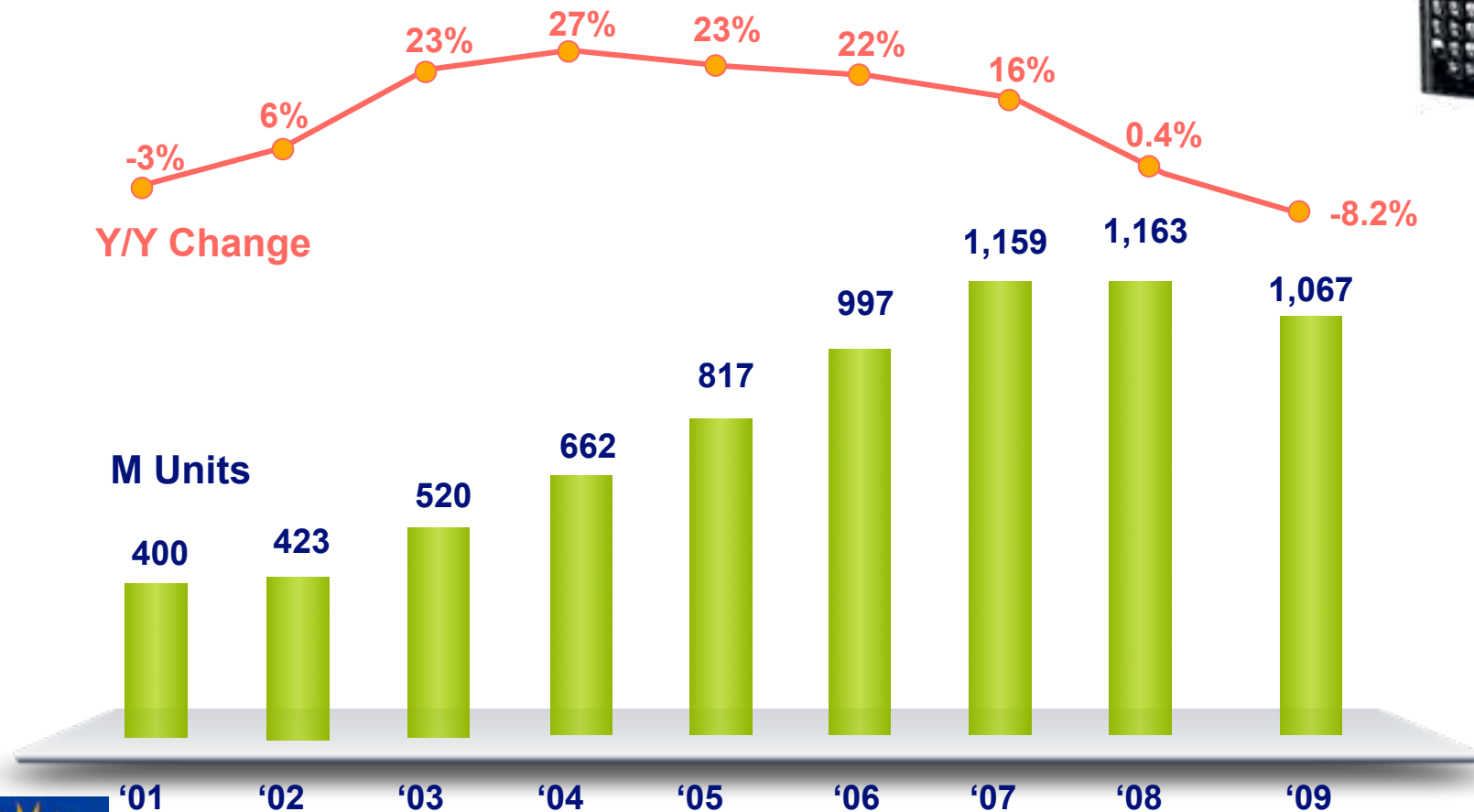


(Source: SEC Jun 2009)



# 2009 Handset Shipment Outlook

- Bad News: Reduced Phone Sales in Aggregate



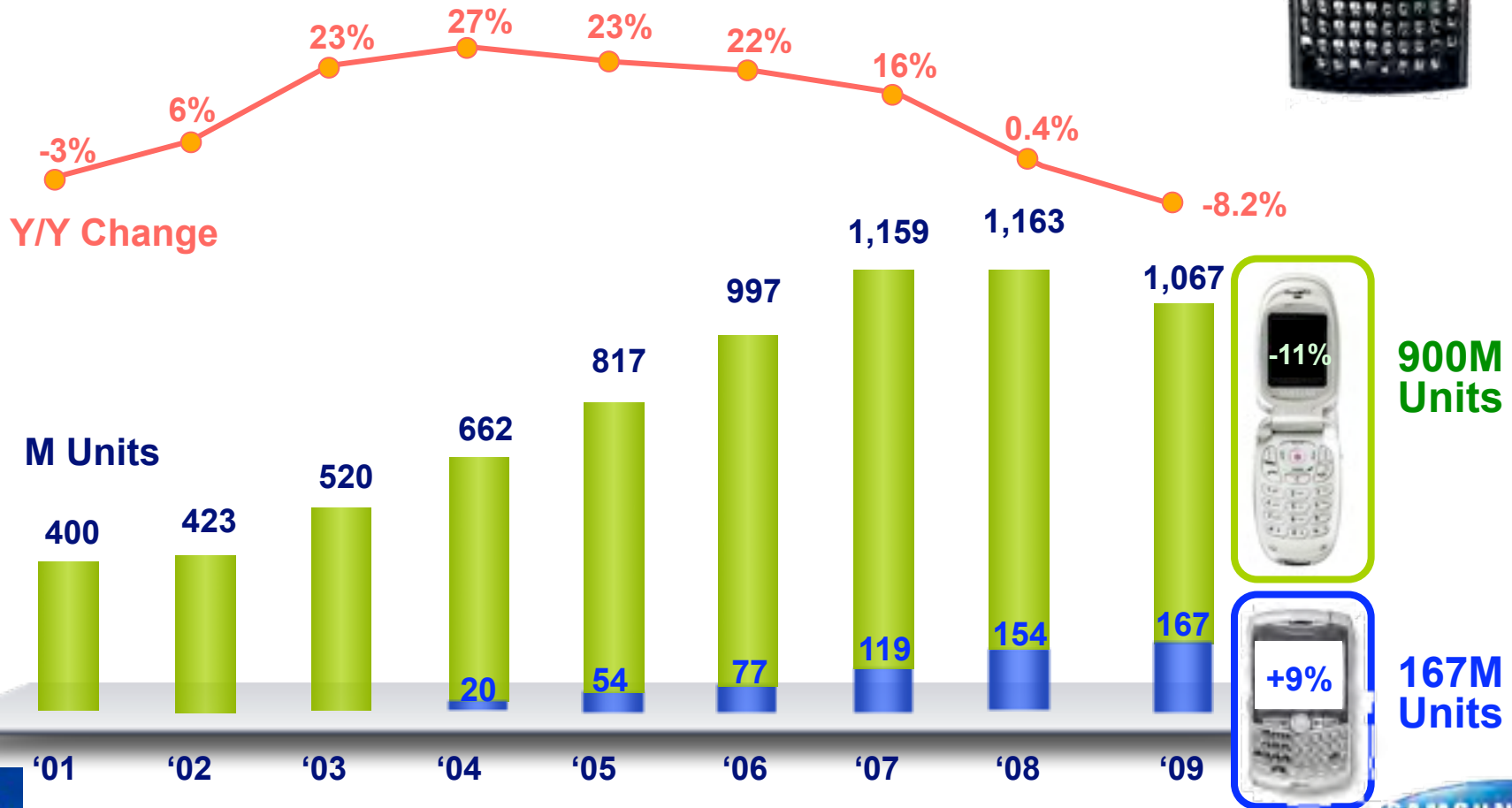
(Source : SA Feb.2009, JP Morgan Mar.2009)





# 2009 Handset Shipment Outlook

- ❑ Bad News: Reduced Phone Sales in Aggregate
- ❑ Good News:
  - ❖ Smart Phones will Continue to Grow in 2009
  - ❖ # of Slotted (Memory Card) Phones Still Increasing...

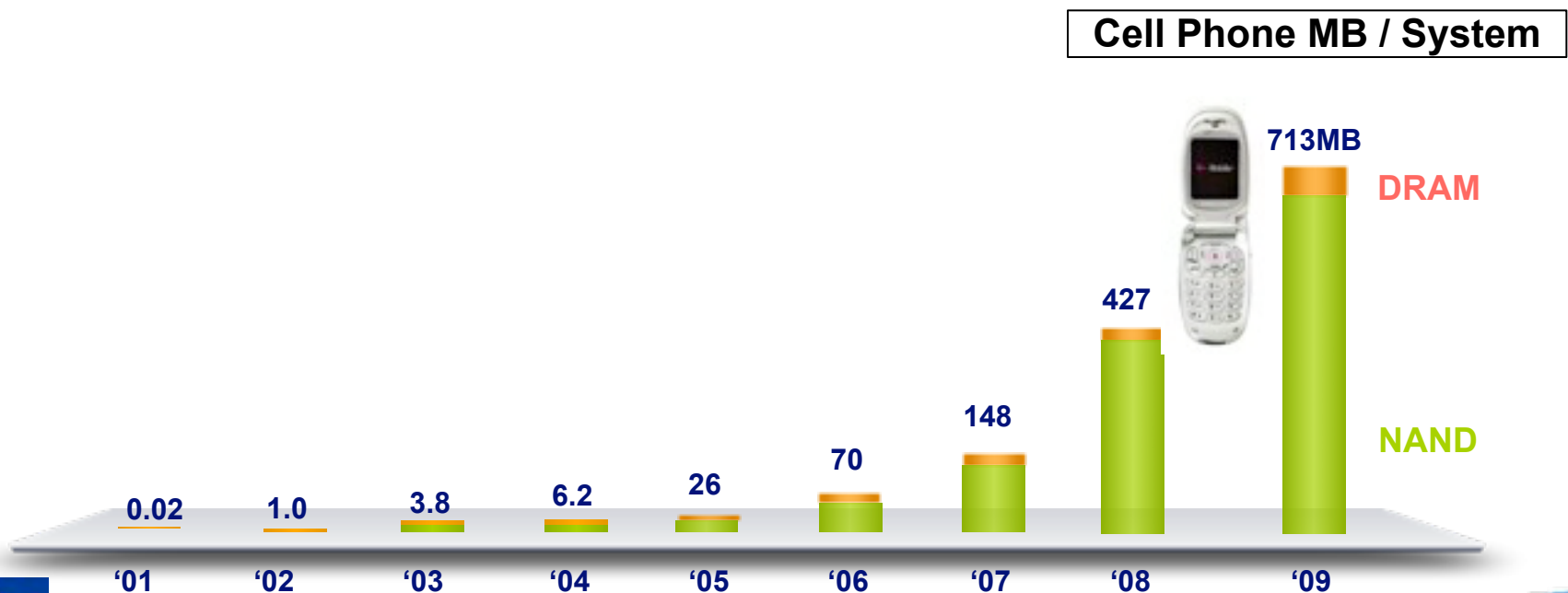


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# Smart Phones Driving GB Content

- NAND Flash Is Primary Beneficiary
  - ❖ Smart Phone Growth Driving GB / System Increases



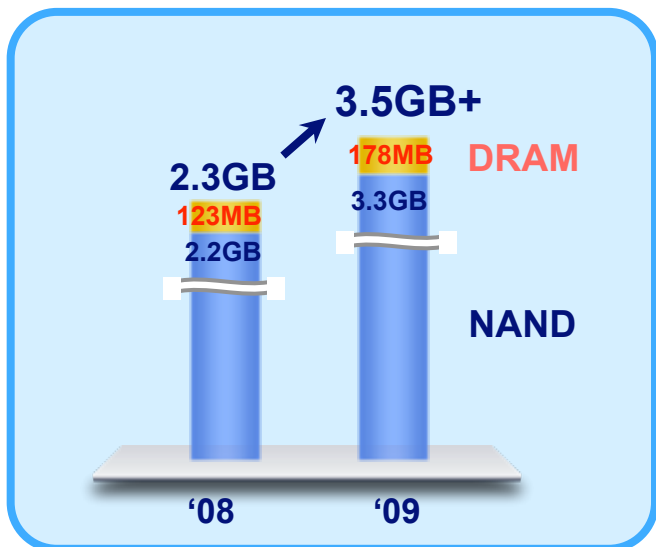
Source : Samsung



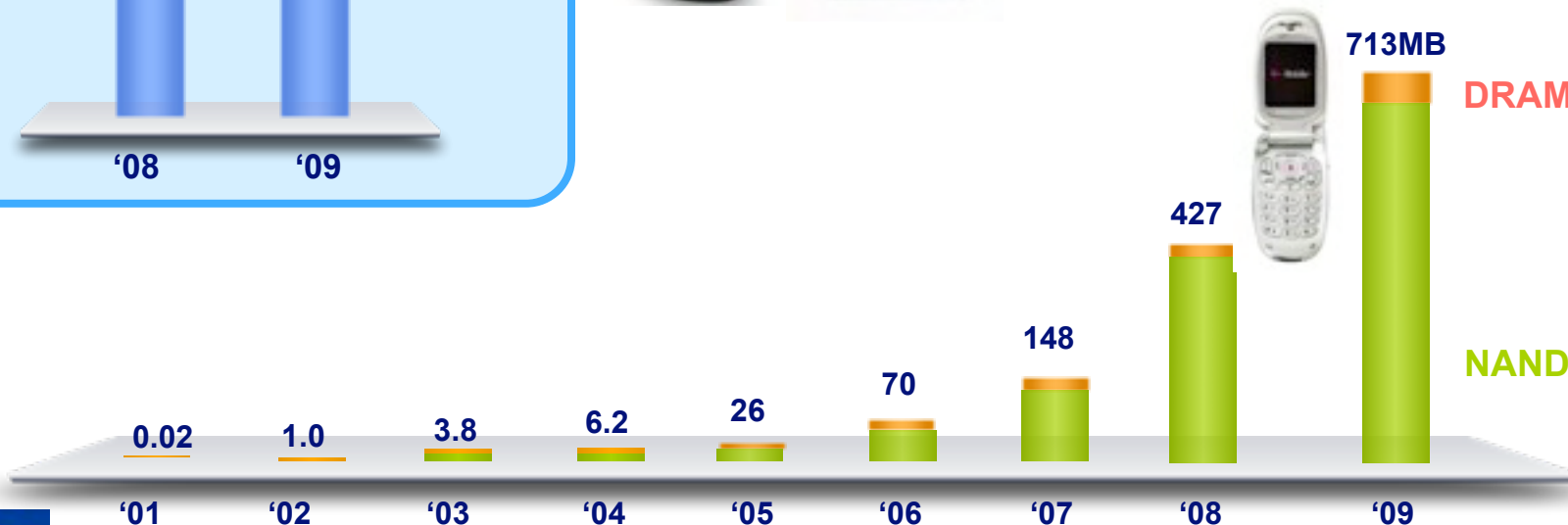
# Smart Phones Driving GB Content

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Smart Phone Memory Content



Cell Phone MB / System

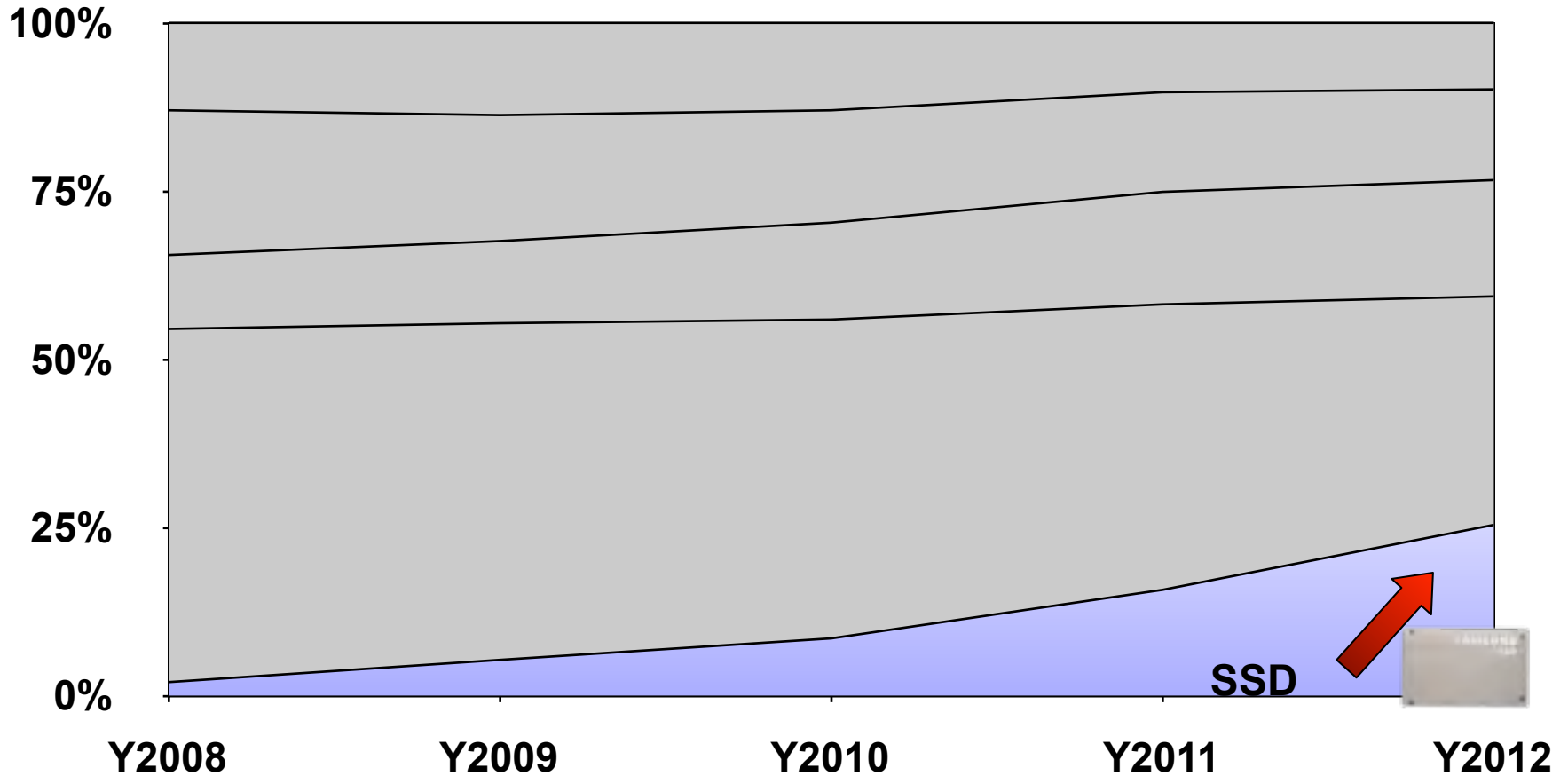


Source : Samsung



# NAND Application Trends

SSD's are the Key NAND Growth Engine...  
Traction in Both Client and Enterprise



(Source: SEC Jun 2009)

# SSD: Then and Now

2007

2009

**Density**



**32GB**

“Lunatic Fringe” Early Adopters

**Speed**



Barely Above HDD

**Price**

30X More per GB  
(\$10/GB SLC)  
Executive Jewelry



# SSD: Then and Now

2007

**Density**



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2009



**256GB**

Suitable Across Categories  
HDD Density at Diminishing Returns in Many Segments

**Speed**



Barely Above HDD

Vendor	Capacity	Max Seq. Read	Max Seq. Write	Type
A	64,128	220	200	MLC
B	64,128,256	230	190	MLC
B	32,64	100	50	SLC
C	32,64	250	170	SLC
C	80,160	250	70	MLC

Saturating SATA 3.0 Seq. R/W of 250MB/s

**Price**

30X More per GB  
(\$10/GB SLC)  
Executive Jewelry



Capacity	Avg.
32GB MLC	\$100
64GB MLC	\$175
128GB	\$360
256GB	\$600



As Low as 5X.  
Benefits with TCO.

# SSD: Then and Now

2007

Density



32GB

“Lunatic Fringe” Early Adopters

2009



256GB

Suitable Across Categories  
HDD Density at Diminishing Returns in Many Segments

Speed



Barely Above HDD

Vendor	Capacity	Max Seq. Read	Max Seq. Write	Interface
A	64,128	230	190	MLC
B	128,256	230	190	MLC
B	32,64	100	50	SLC
C	32,64	250	170	SLC
C	80,160	250	70	MLC

Saturating SATA 3.0  
Seq. R/W of 250MB/s

Extrapolate These Trends Over Time...

Price

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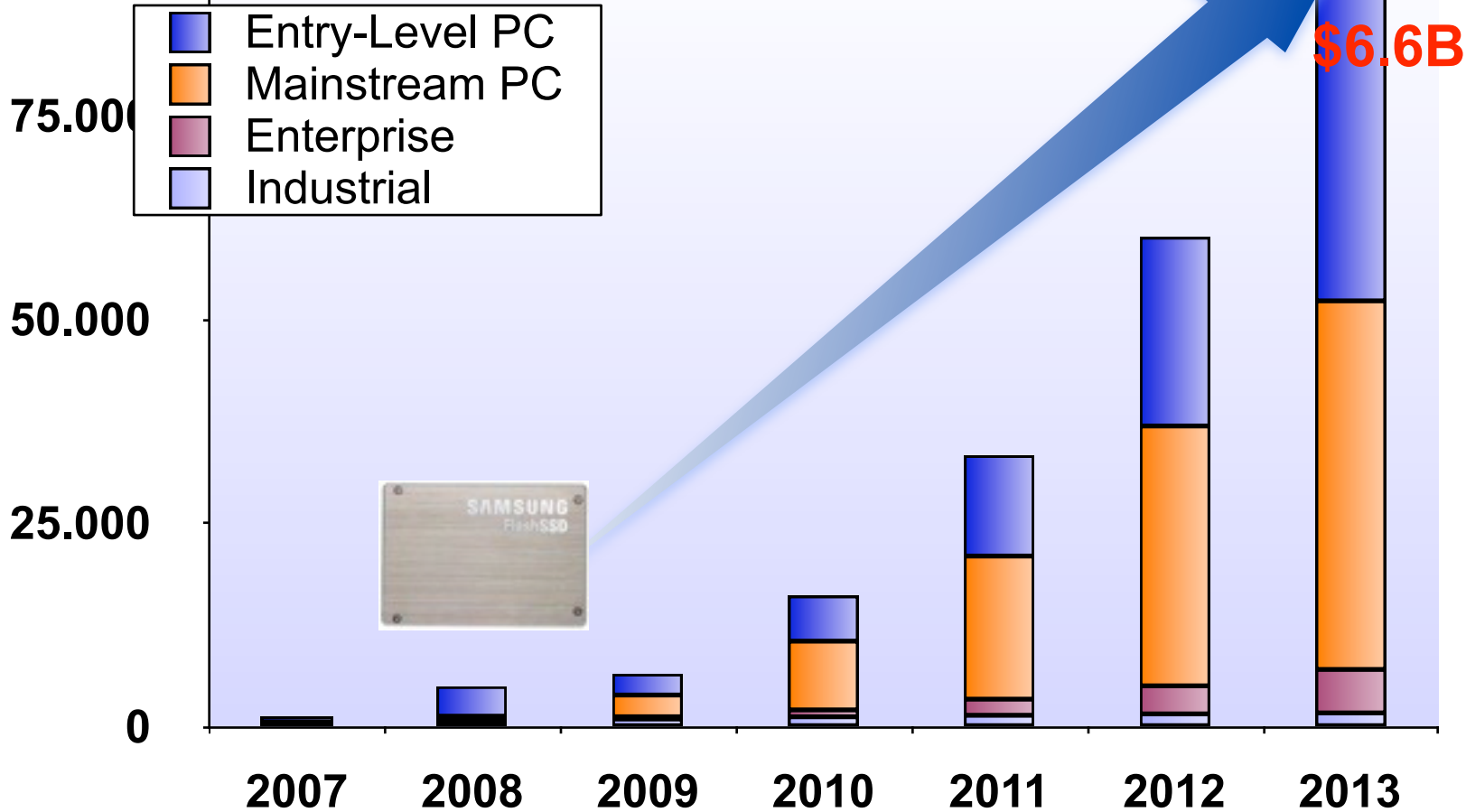
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# SSD Proliferation has Begun

Million Units

100.000

## SSD Growth to Outpace ALL Other NAND Applications



\$6.6B

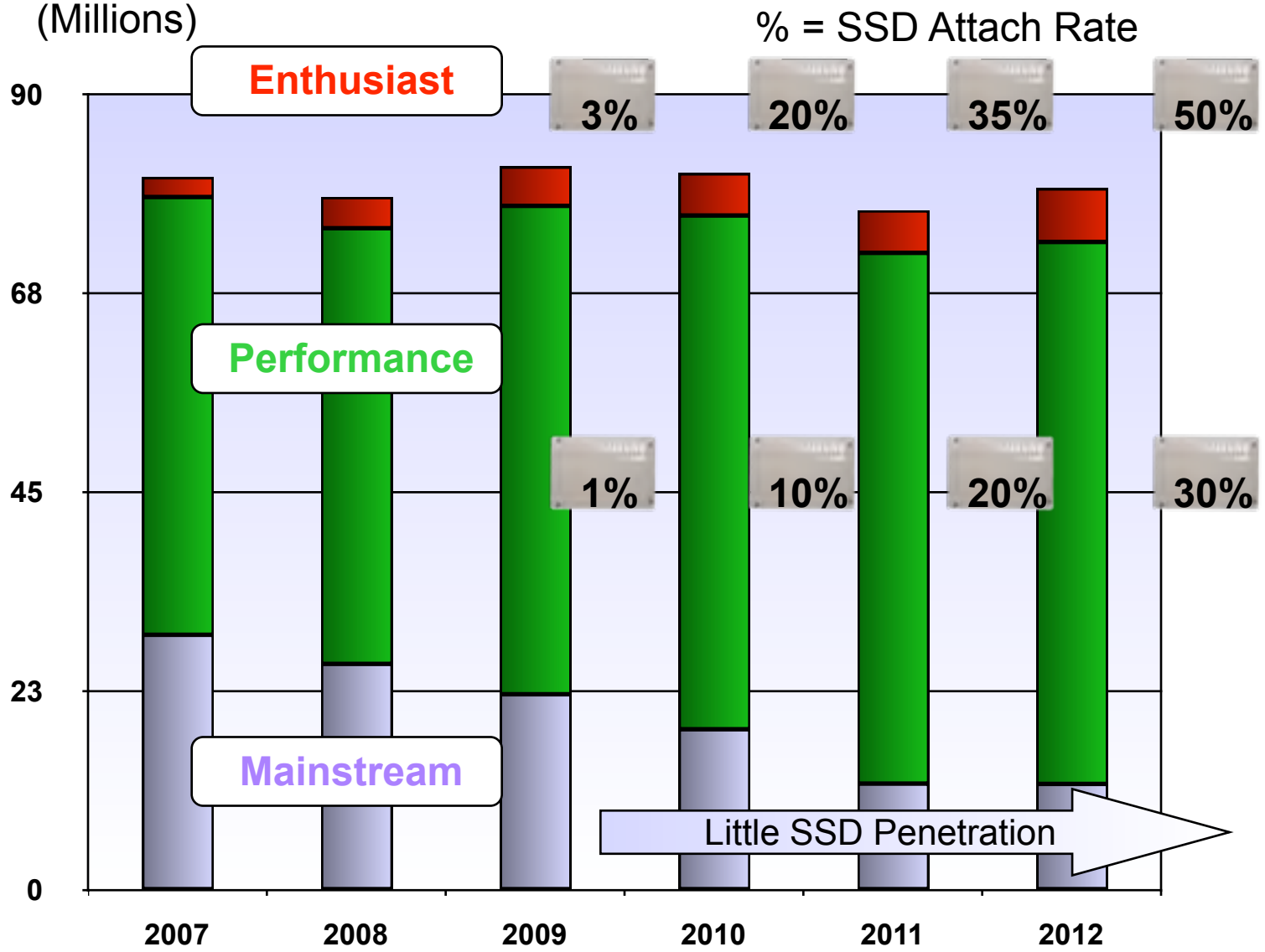
(Source: Gartner July'09)





# Beyond NB: Gaming PC Market

Gaming PC,  
GPU Units:  
(Millions)



## Segment

**Enthusiast**



**Performance**



**Mainstream**



Source: Jon Peddie Research, Aug, 2009



# SSD Gaming Performance Advantage

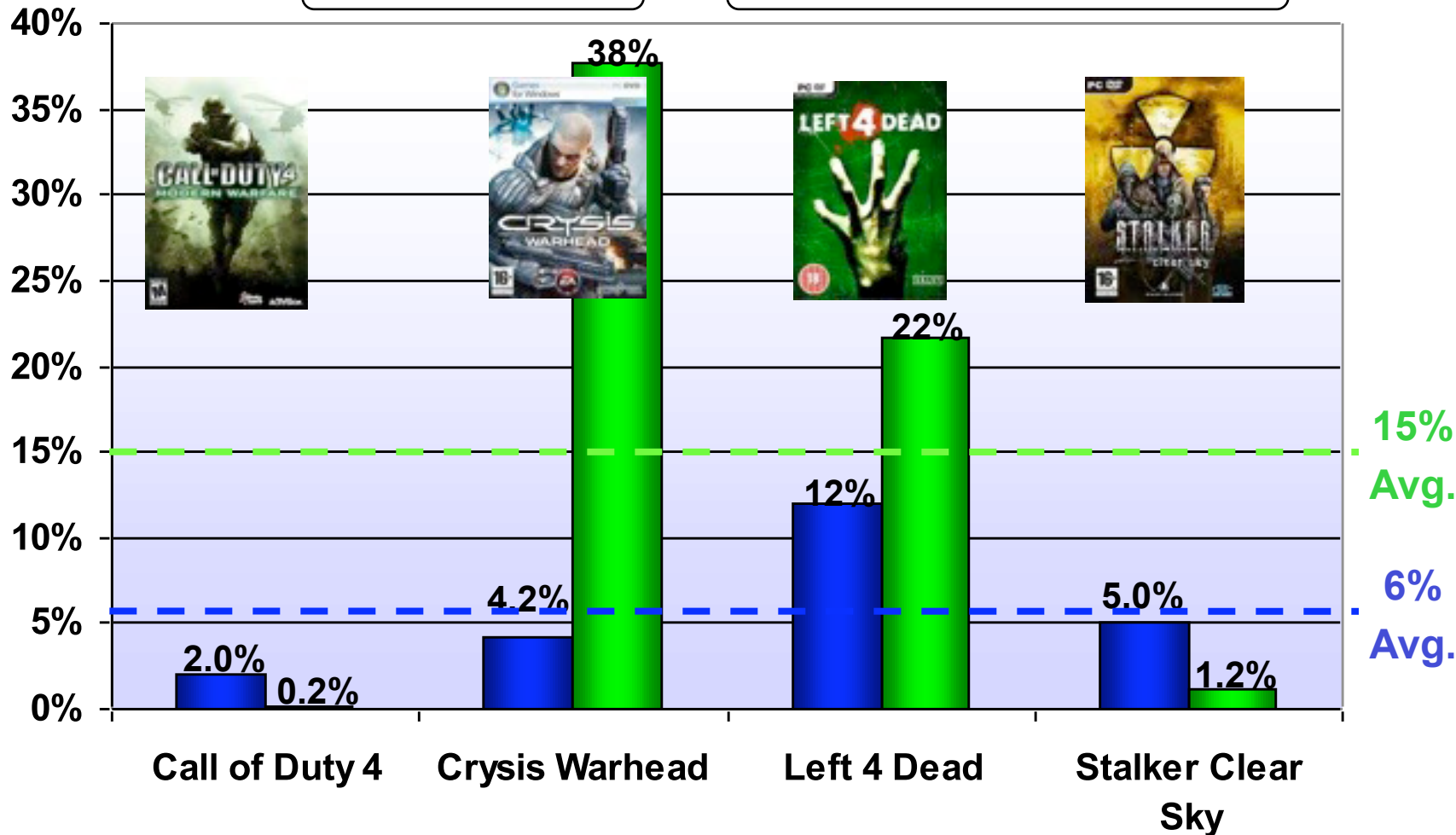
SSD Advantage



Load Time



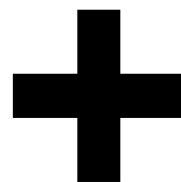
FRAPS (frames / sec)



Source: Jon Peddie Research, Aug, 2009, Samsung 256GB SSD vs. WD1500HLFS, 10K, 150GB



# How SSD's & Smart Phones Connect

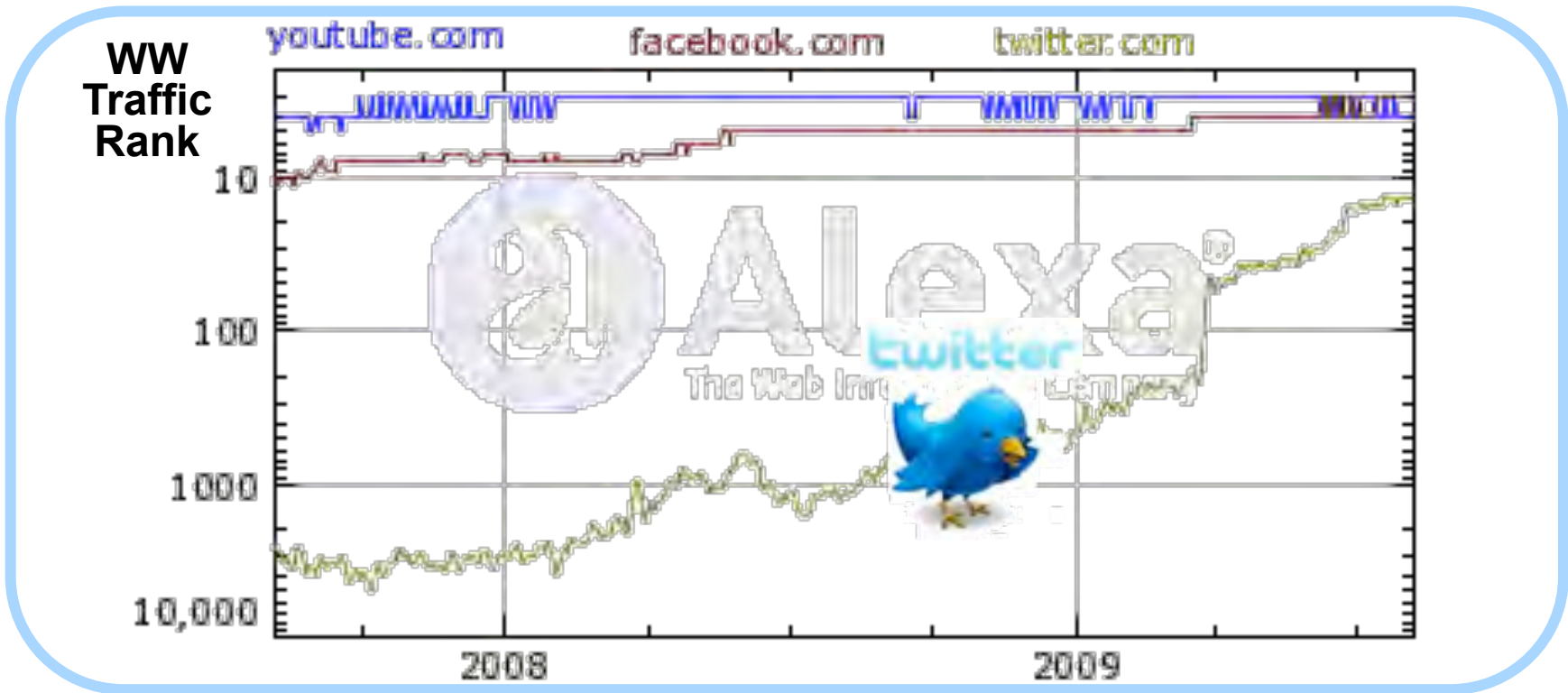


# Social Networking As A Killer-App

- FaceBook, YouTube, Twitter, etc.
  - ❖ Changing the Communication Paradigm

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**Drives Connectivity, Unit Sales, Content, Infrastructure Requirements**  
**P2P Content Accessed via Cell Phone and Smart Phone...**

# Impact of Facebook...



Welcome to the new Facebook Send feedback

**facebook**  Remember Me [Forgot your password?](#)

**Facebook helps you connect and share with the people in your life.**

**Sign Up**  
It's free and anyone can join

Full Name:   
Your Email:

You will need to provide this information to create your profile. By clicking Sign Up, you are indicating that you have read and agree to the Terms of Use and Privacy Policy.

Facebook is constantly trying to upgrade its infrastructure to keep up with growth in users and data, while trying to minimize power consumption to save money...

-- Jonathan Heiliger, VP Technical Operations

- ❑ #3 Internet Site (Google, Yahoo!)
- ❑ >250M Active Users
  - ❖ 120M Log on Every Day
  - ❖ 1 Billion Photos Uploaded per Month
  - ❖ >10M Videos Uploaded per Month
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- ❑ >30M Users Access Facebook via Mobile Phone
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**facebook**

Profound Impact on Connected Devices, Usage Patterns and Infrastructure (SSD!)



# Twitter: From “Tweet” to “Roar”



- 44.5M Unique Visitors in June '09
  - ❖ 19% Increase in one Month!
  - ❖ ~16X Growth from June 2008



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## ❑ 44.5M Unique Visitors in June '09

- ❖ 19% Increase in one Month!
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## ❑ Agent for Social Change?

- ❖ US State Department asked Twitter to postpone a planned maintenance shutdown due to the situation in Iran...
- ❖ Real-Time Protest / News Updates, 140 Characters at a Time

## ❑ Transformational Events Will Re-Shape IT, CE and Tech

- ❖ PC Sales,  \$3M, Smart Phone Sales, Enterprise Infrastructure...



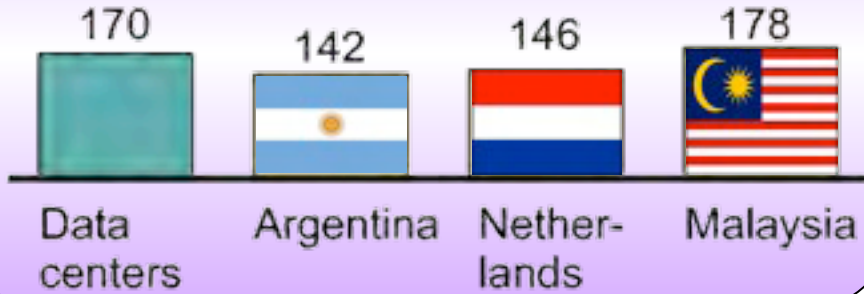
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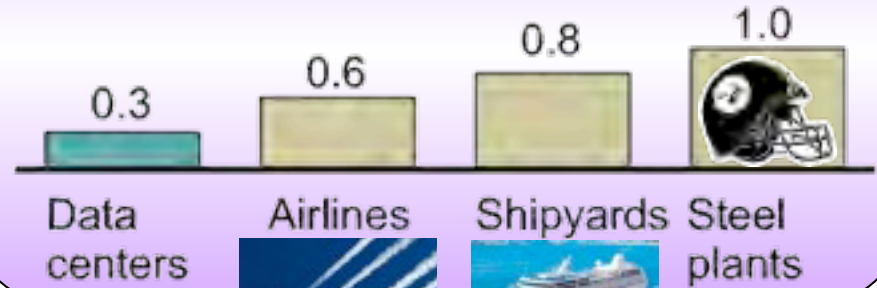
# Enterprise: Ripe for Disruption...



Carbon emissions – countries  
Mt CO<sub>2</sub> p.a.



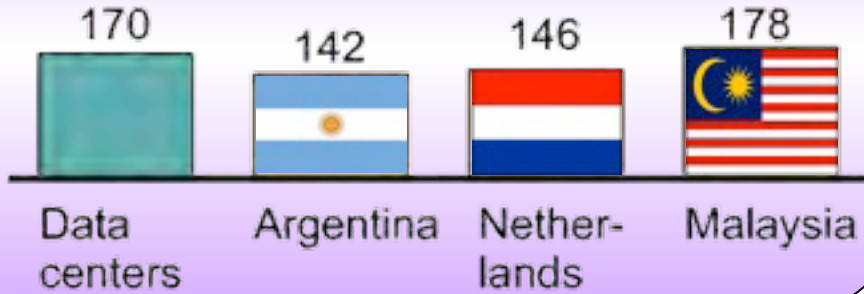
Carbon dioxide emissions as  
percentage of world total – industries  
Percent



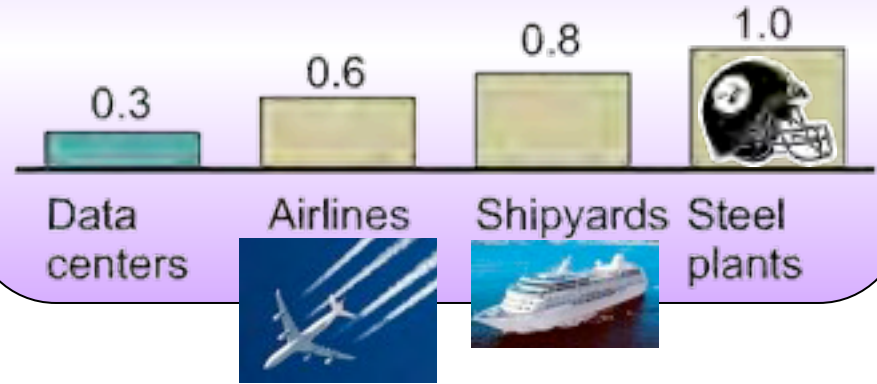
# Enterprise: Ripe for Disruption...



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Mt CO<sub>2</sub> p.a.



Carbon dioxide emissions as percentage of world total – industries  
Percent



## ? Did You Know...

America consumes more power running data centers than TVs.  
~3% of US Electricity by 2011

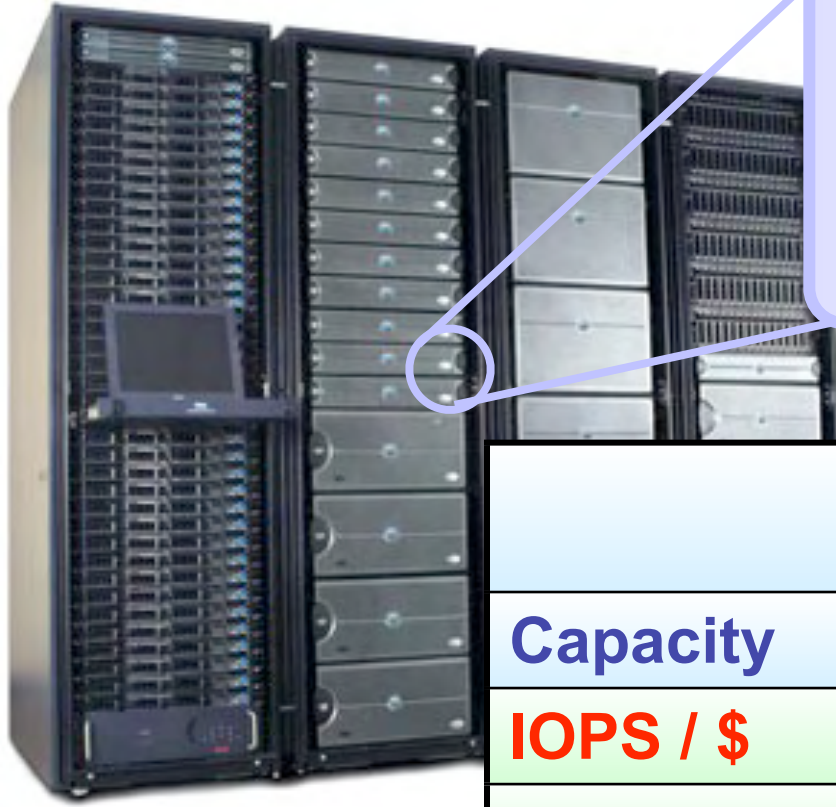


\* Source : 2008 McKinsey Study, *Fortune*, Sept 15, 2008





# SSD Disruptive to Enterprise: IOPS/\$, IOPS/W



	15K HDD 3.5"	SSD 2.5"
<b>Capacity</b>	<b>146GB</b>	<b>100GB</b>
<b>IOPS / \$</b>	<b>0.7</b>	<b>12X 1</b>
<b>IOPS / W</b>	<b>30</b>	<b>202X 265</b>

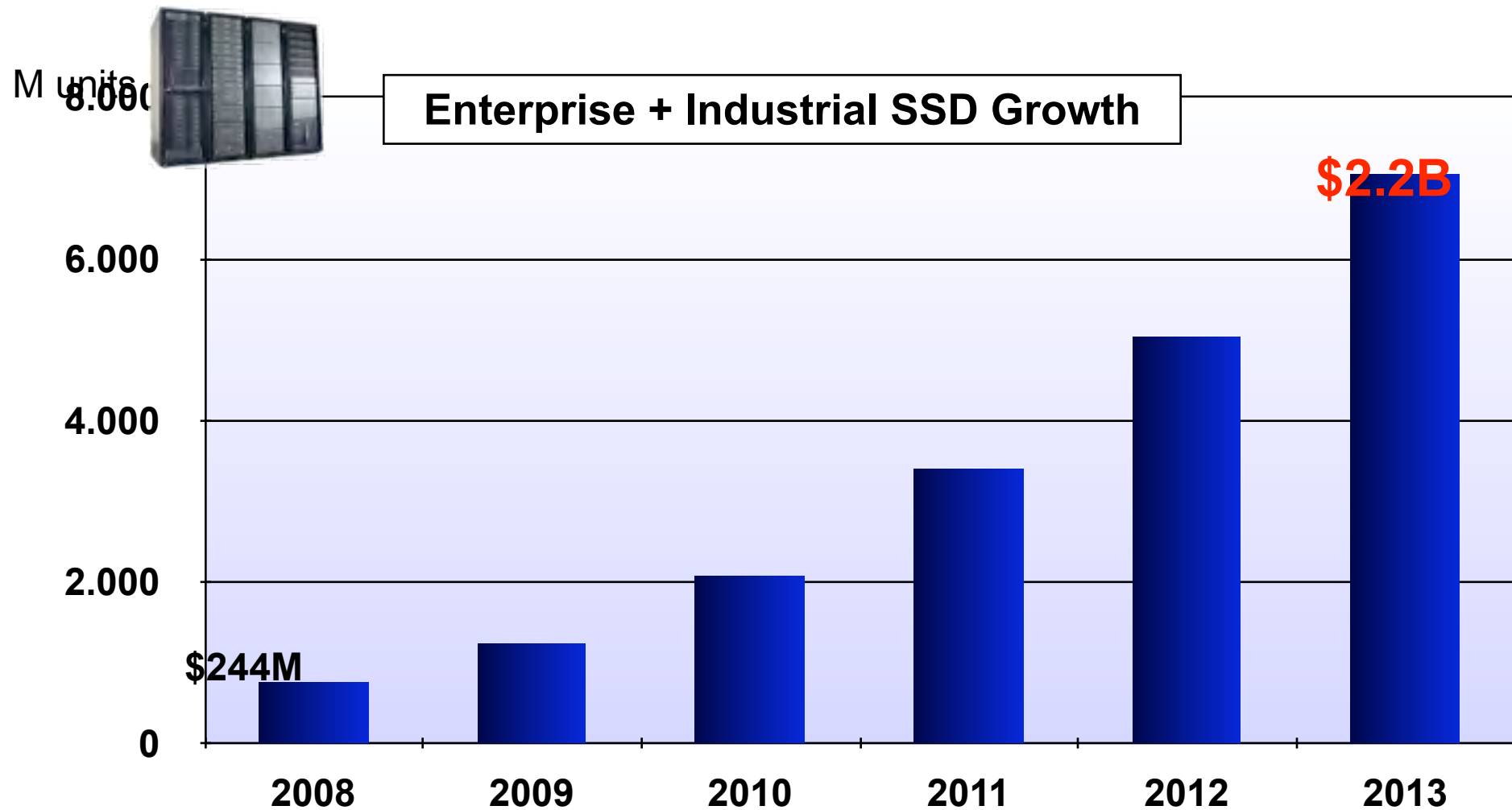
**“Orders of Magnitude Improvement”**

\*SSD: IOPS - random read @ 512B, Data (Samsung)

\*HDD: Price and Data from storagereview.com; IOPS: average read speed



# SSD Growth in Enterprise / Industrial



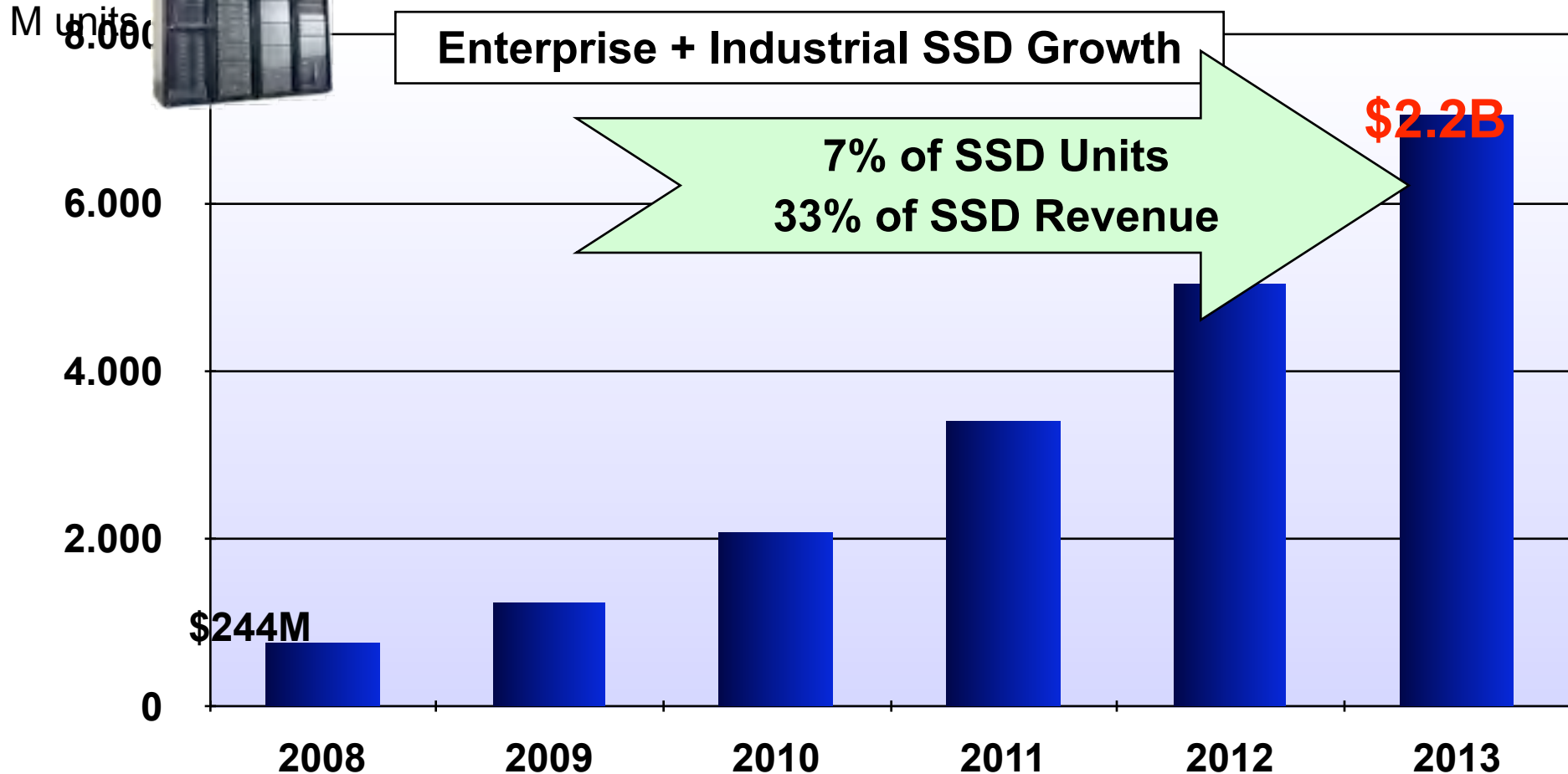
[Source : Gartner]



# SSD Growth in Enterprise / Industrial

Disparity Between Revenue and Units Shows Value Proposition

High TCO Benefits: IOPS, Power Efficiency, Cooling, Smaller Footprint

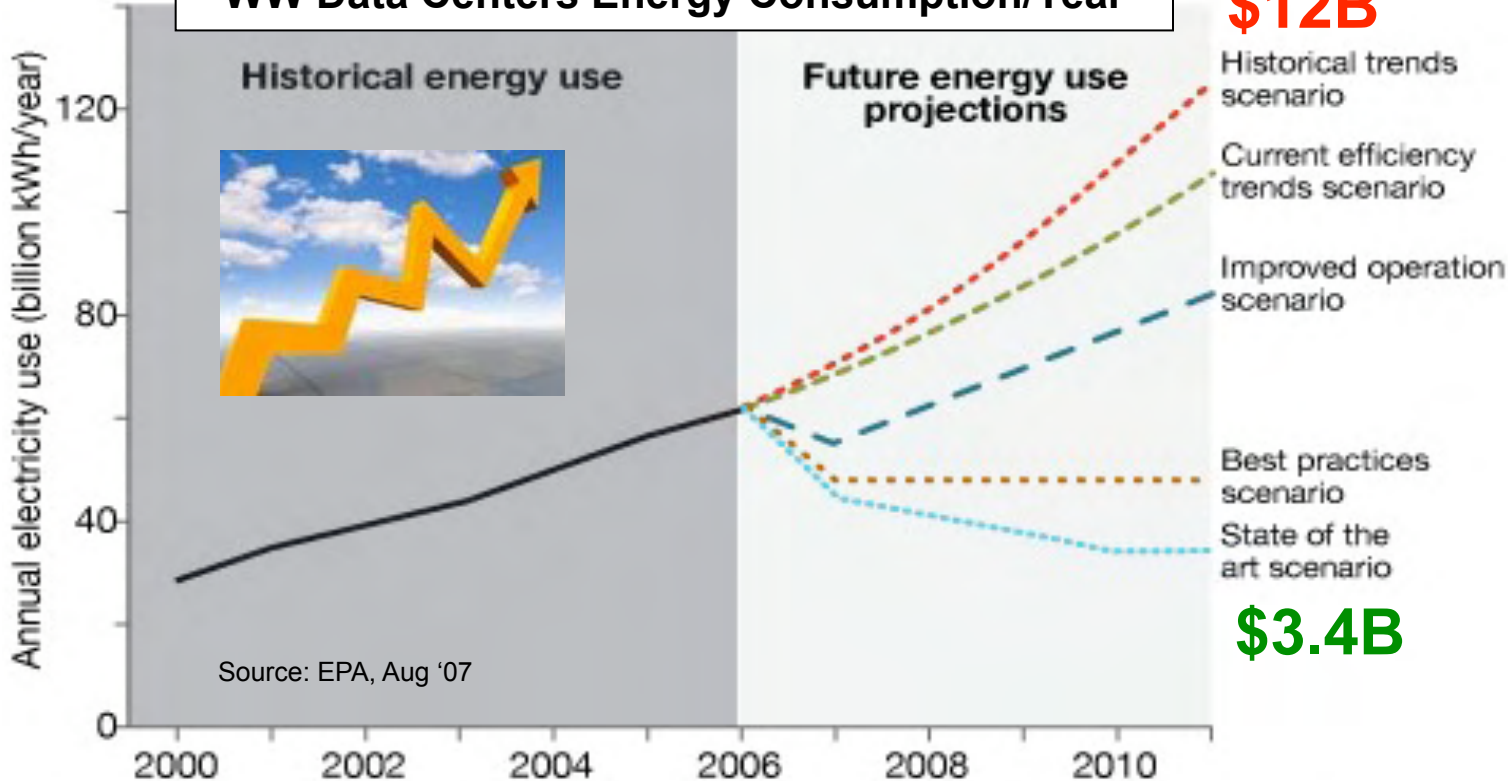


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# Enterprise: Path to Energy Efficiency

WW Data Centers Energy Consumption/Year



**\$12B**

Historical trends scenario

Current efficiency trends scenario

Improved operation scenario

Best practices scenario

State of the art scenario

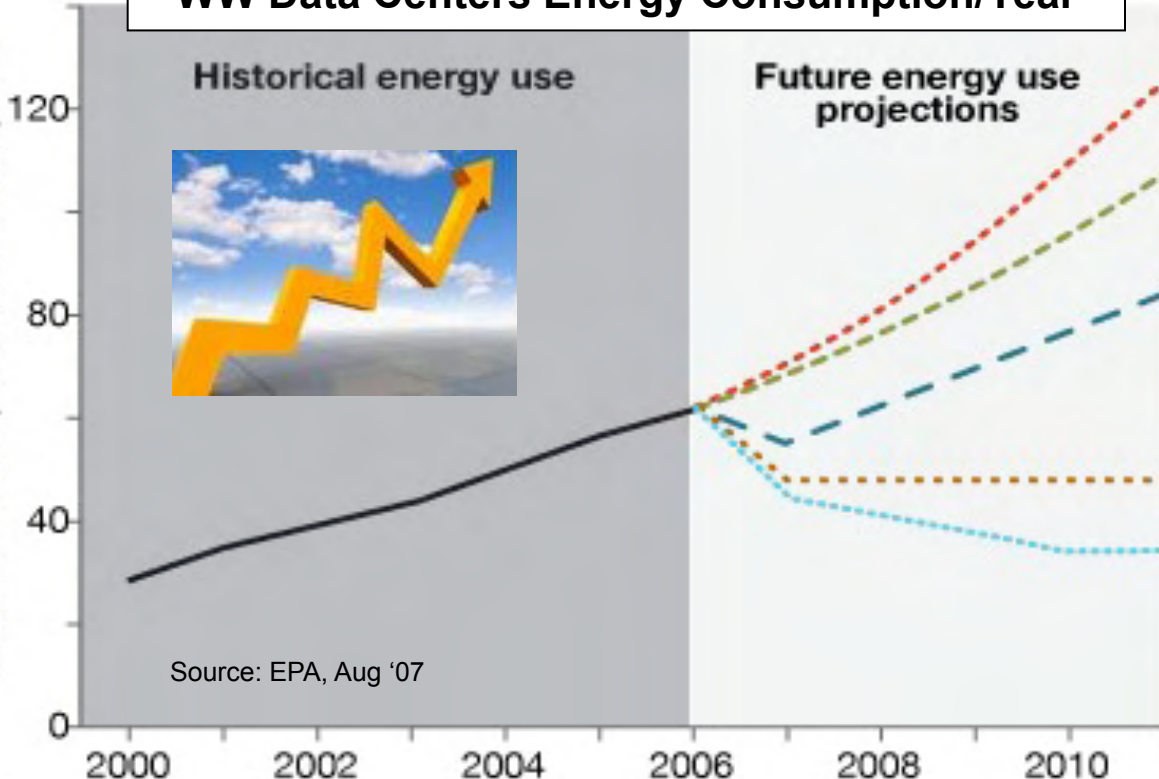
**\$3.4B**



# Enterprise: Path to Energy Efficiency

WW Data Centers Energy Consumption/Year

Annual electricity use (billion kWh/year)



Source: EPA, Aug '07

**\$12B**

Historical trends scenario

Current efficiency trends scenario

Improved operation scenario

Best practices scenario

State of the art scenario

**\$3.4B**

DDR2 / HDD

Virtualization

DDR3 / SSD



## New "Energy Star" Spec for Servers

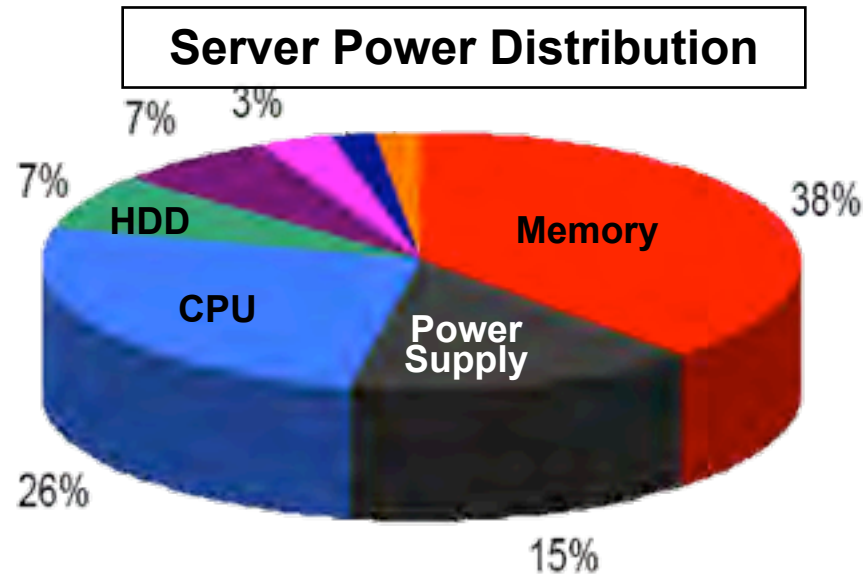
Version 1.0 Just Released in May 2009

Data Center Spec Coming Soon...



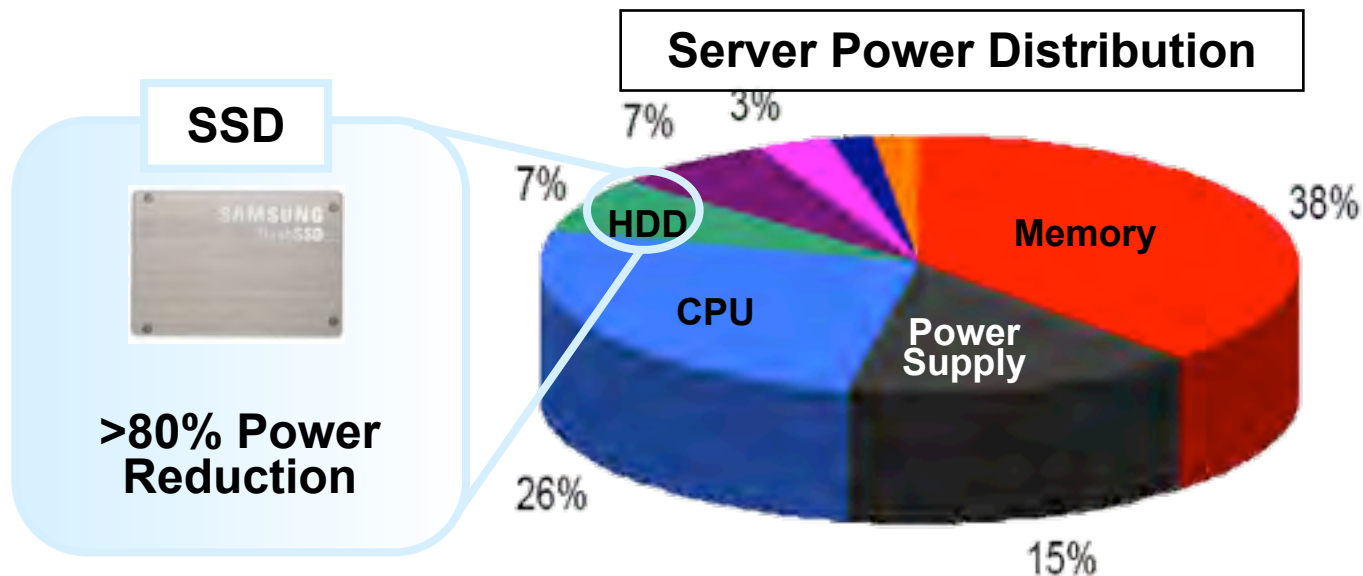
# Call to Action: Make a Difference, Now!

2011: ~3% of US Electricity from Data Centers



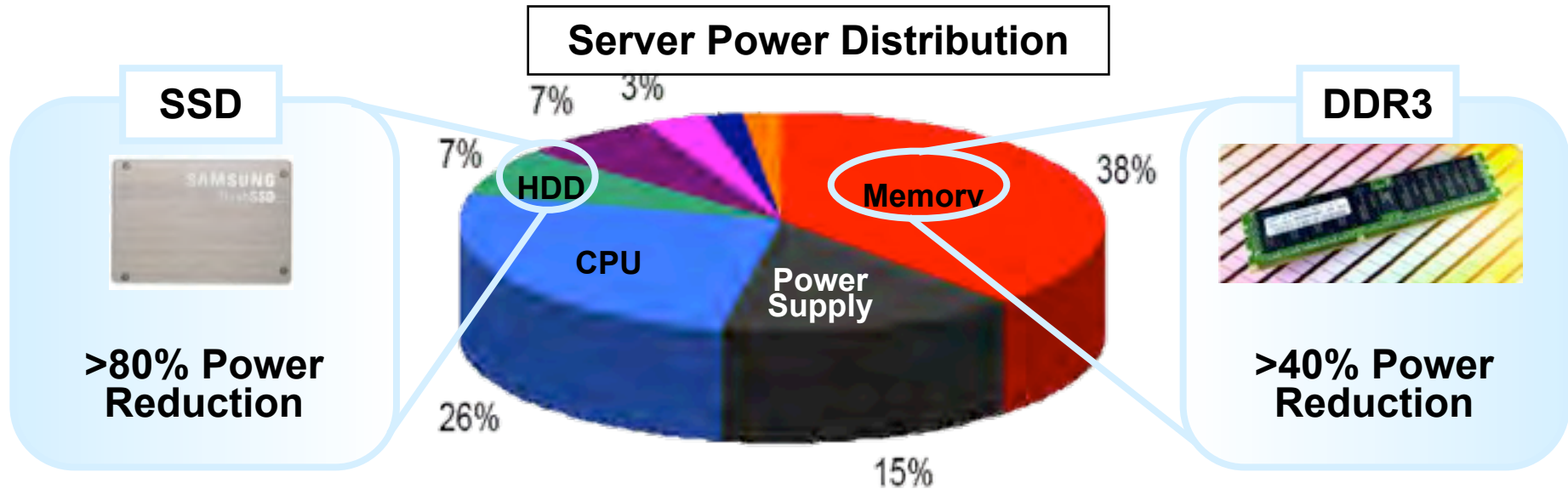
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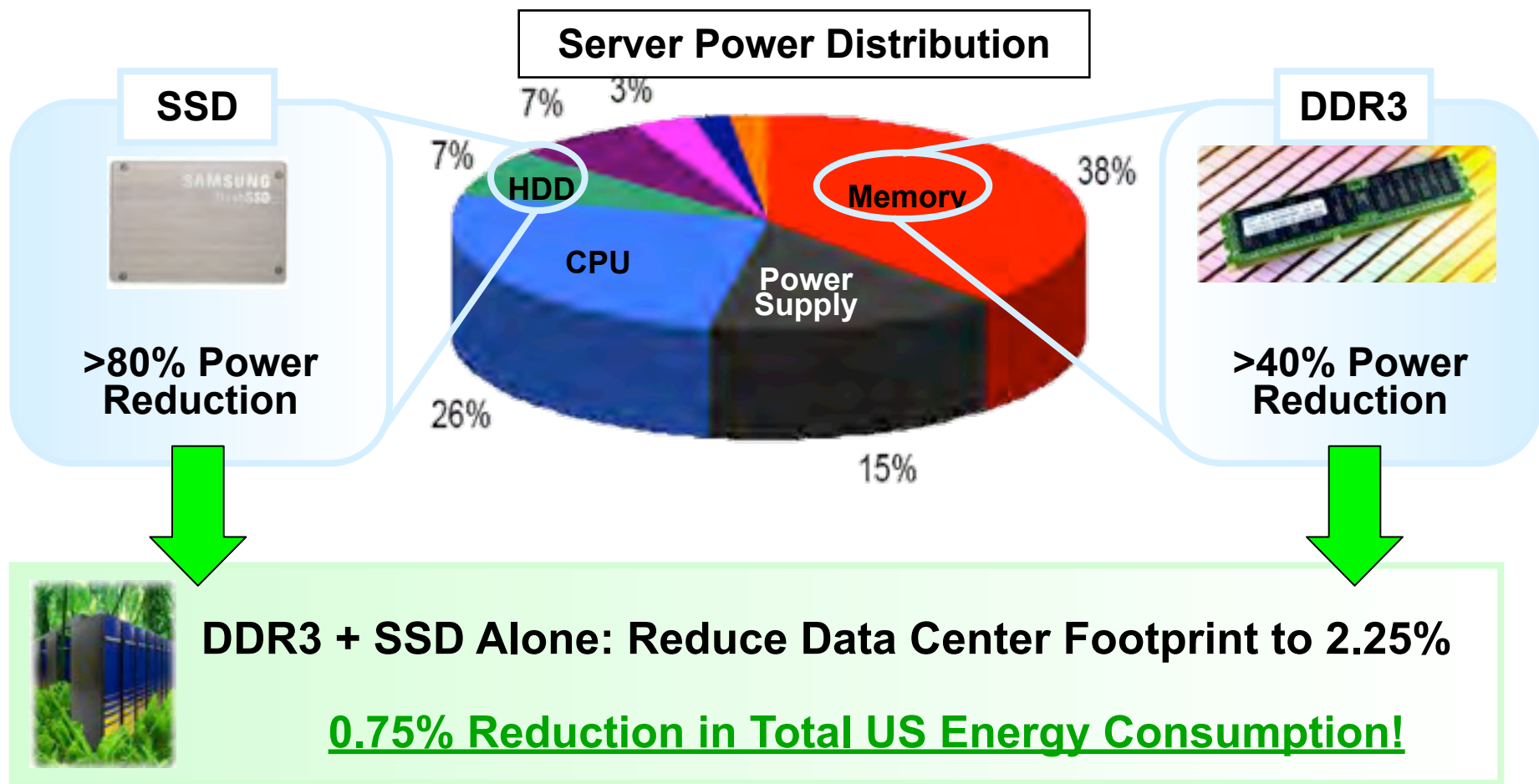
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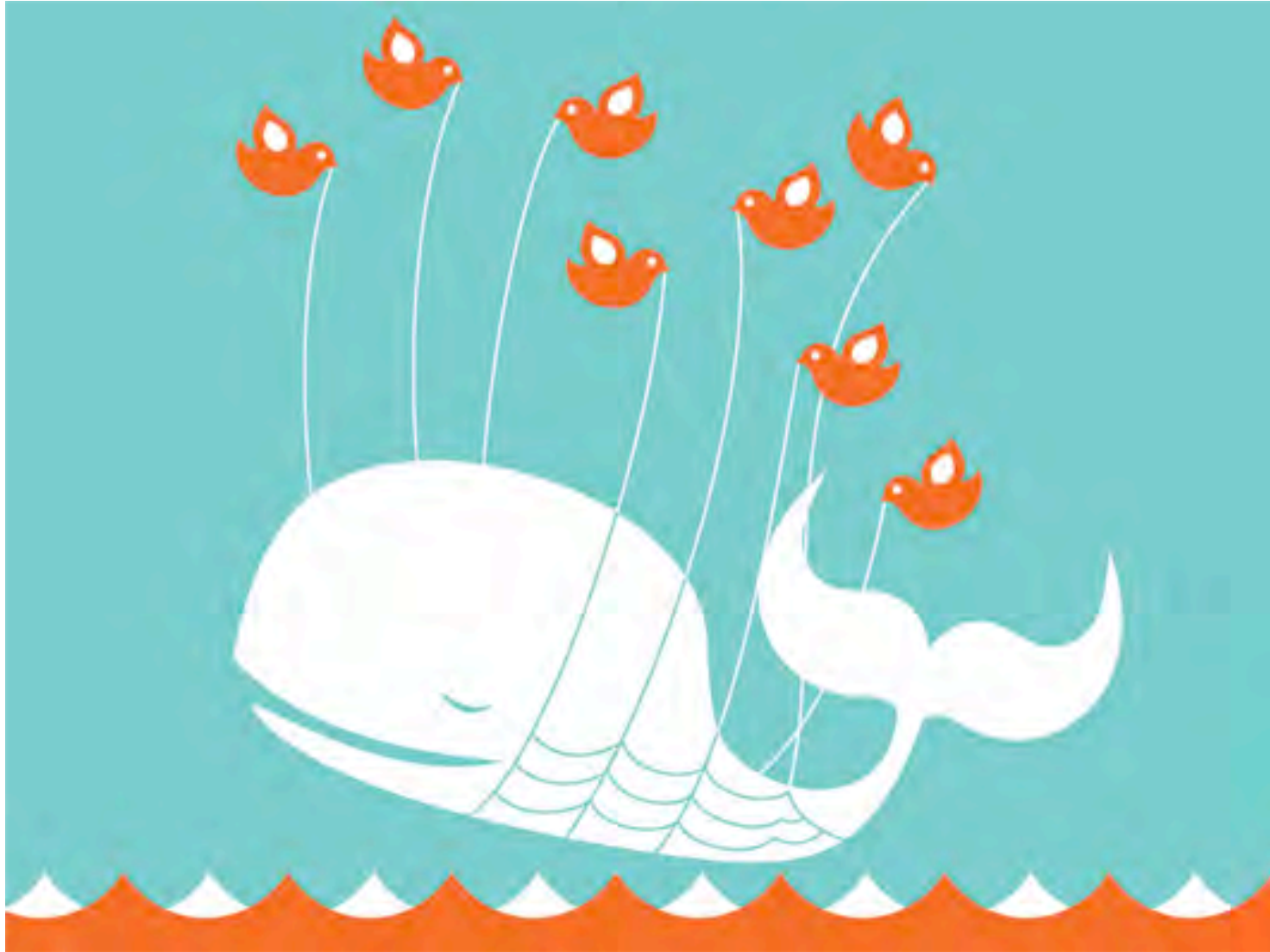


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# Closing Comments...



# Fail Whale – P2P Impact

**LONDON, England (CNN)** -- How many people does it take to break the Internet?



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On June 25, we found out it's just one -- if that one is Michael Jackson.





# Fail Whale – P2P Impact

**LONDON, England (CNN)** -- How many people does it take to break the Internet?

On June 25, we found out it's just one -- if that one is Michael Jackson.



Twitter crashed as users saw multiple "fail whales"

→ Michael Jackson's death was responsible for 30 percent of tweets

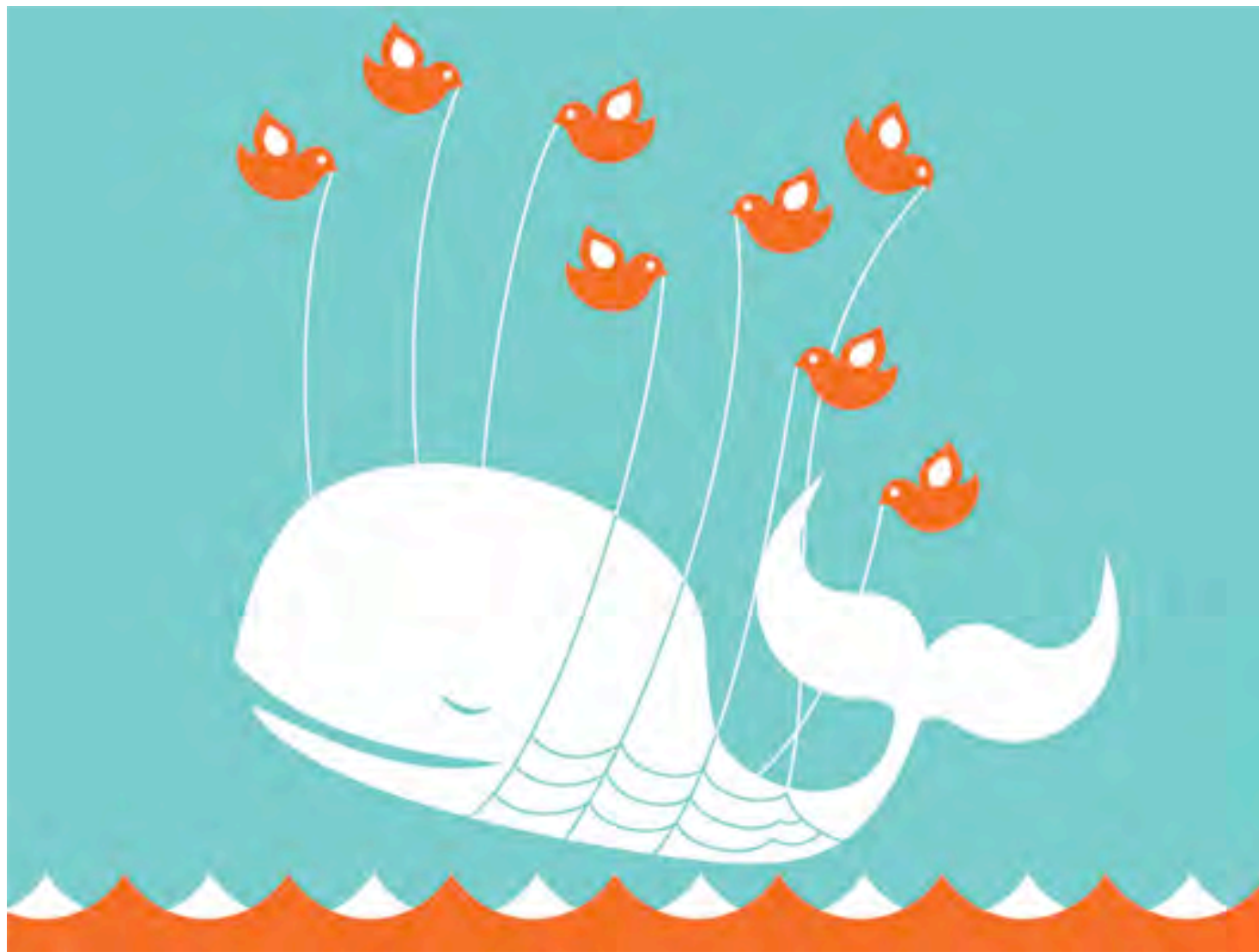
Wikipedia seemed to be "temporarily overloaded," according to CNET

AOL's instant messenger service had been hit

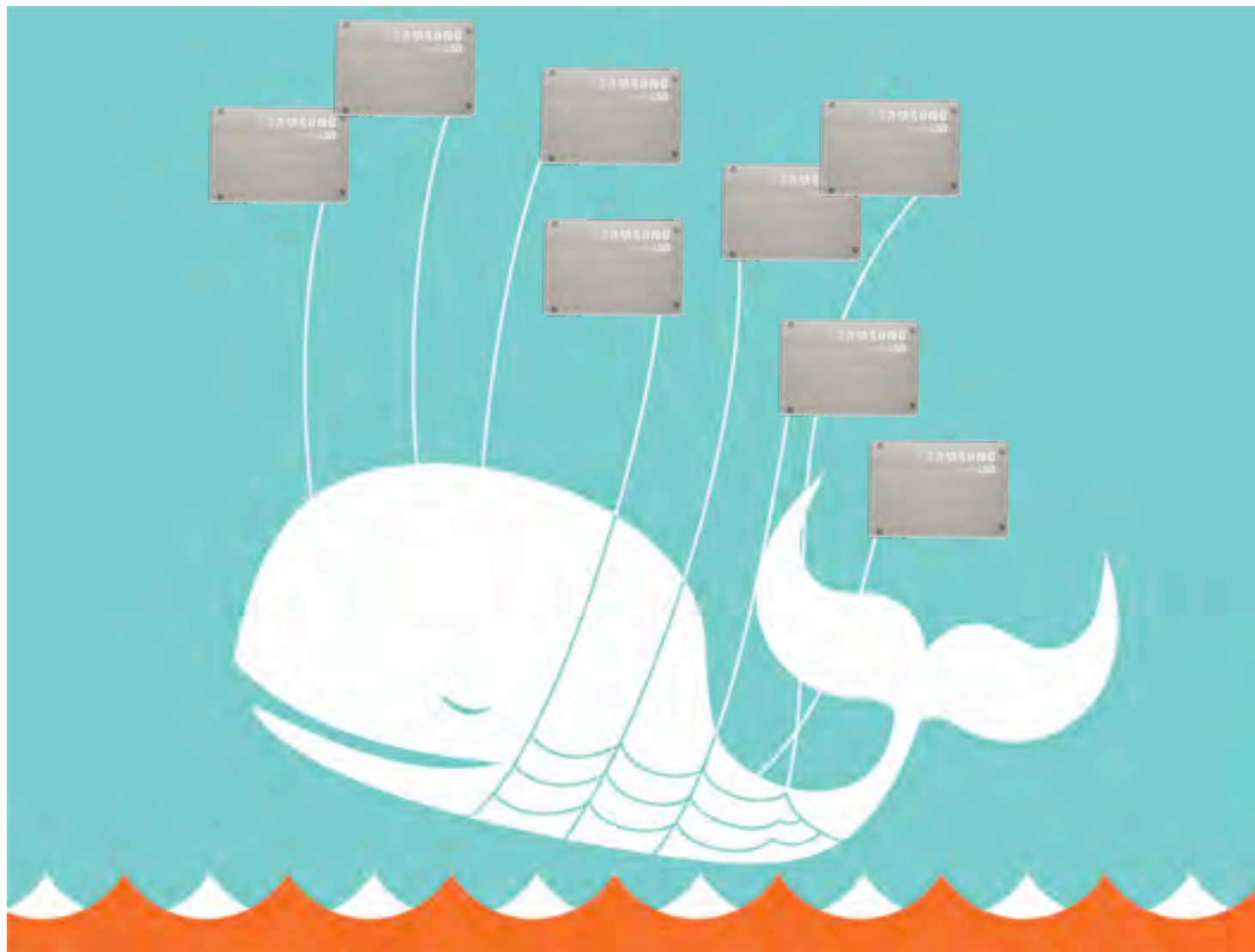
**"It could go down as the biggest mobile event in history"**

-- AOL consumer adviser Regina Lewis

# Can the Fail Whale Be Prevented?



# Can the Fail Whale Be Prevented?





# Thank You

twitter

[Home](#) [Profile](#) [Find People](#) [Settings](#) [Help](#) [Sign out](#)

What are you doing?

140

I am heading out for media interviews...

Latest: Check out my Keynote Speech at Flash Memory Summit tomorrow at 2PM. There might be a 256GB SSD in it for yo... less than 5 seconds ago

update



Jimelliott70

37

[following](#)

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**We Follow**

n. a directory of interesting Twitter accounts.