

JEDDEC

Global Standards for the Microelectronics Industry

**DISCOBOLUS
DESIGNS**

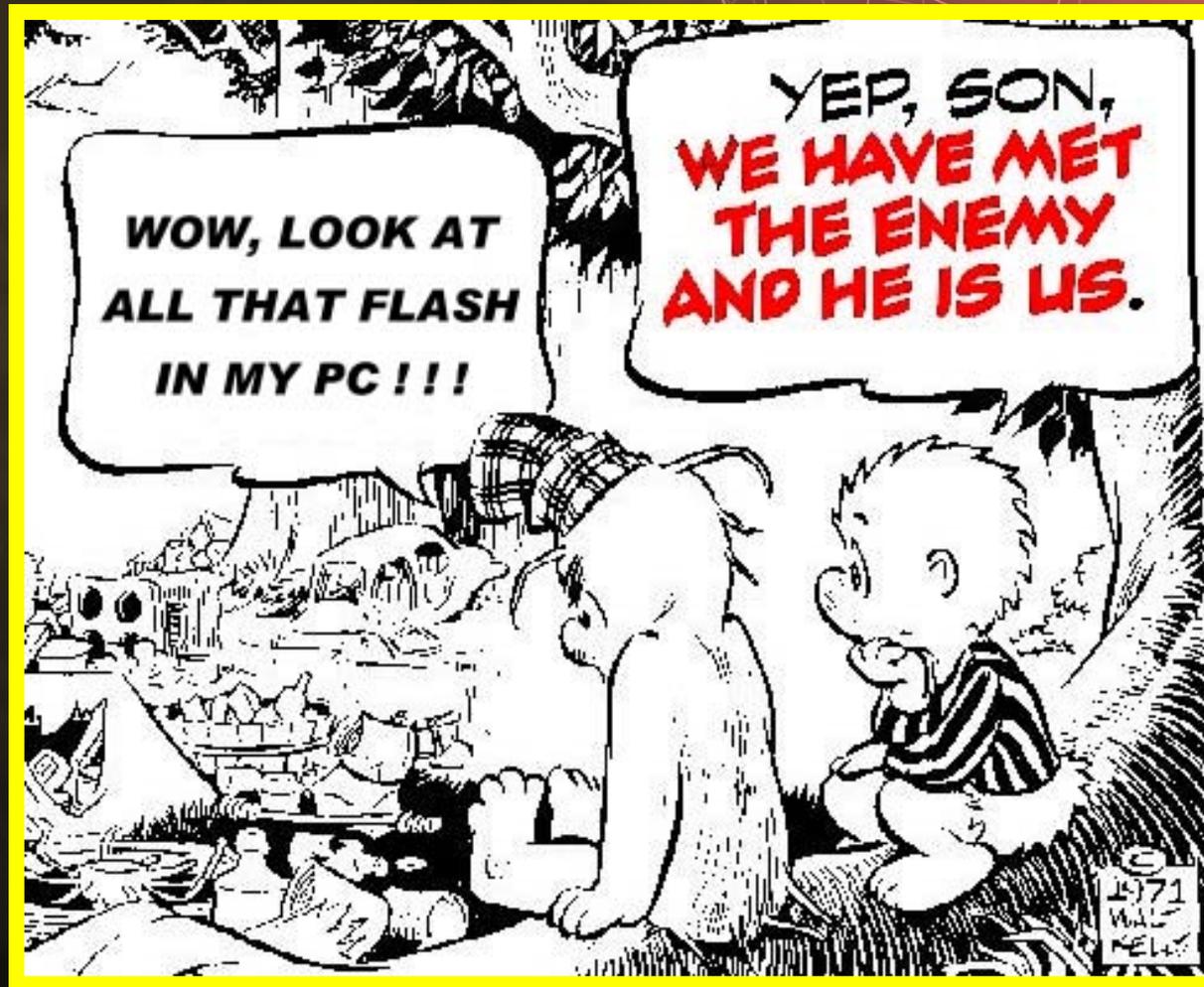
 **FORMFACTOR**

Morphing SSD Into Mainstream Computing Architectures

Bill Gervasi
April 2009

Flash Storage Summits 2009 - Future of Flash Memory

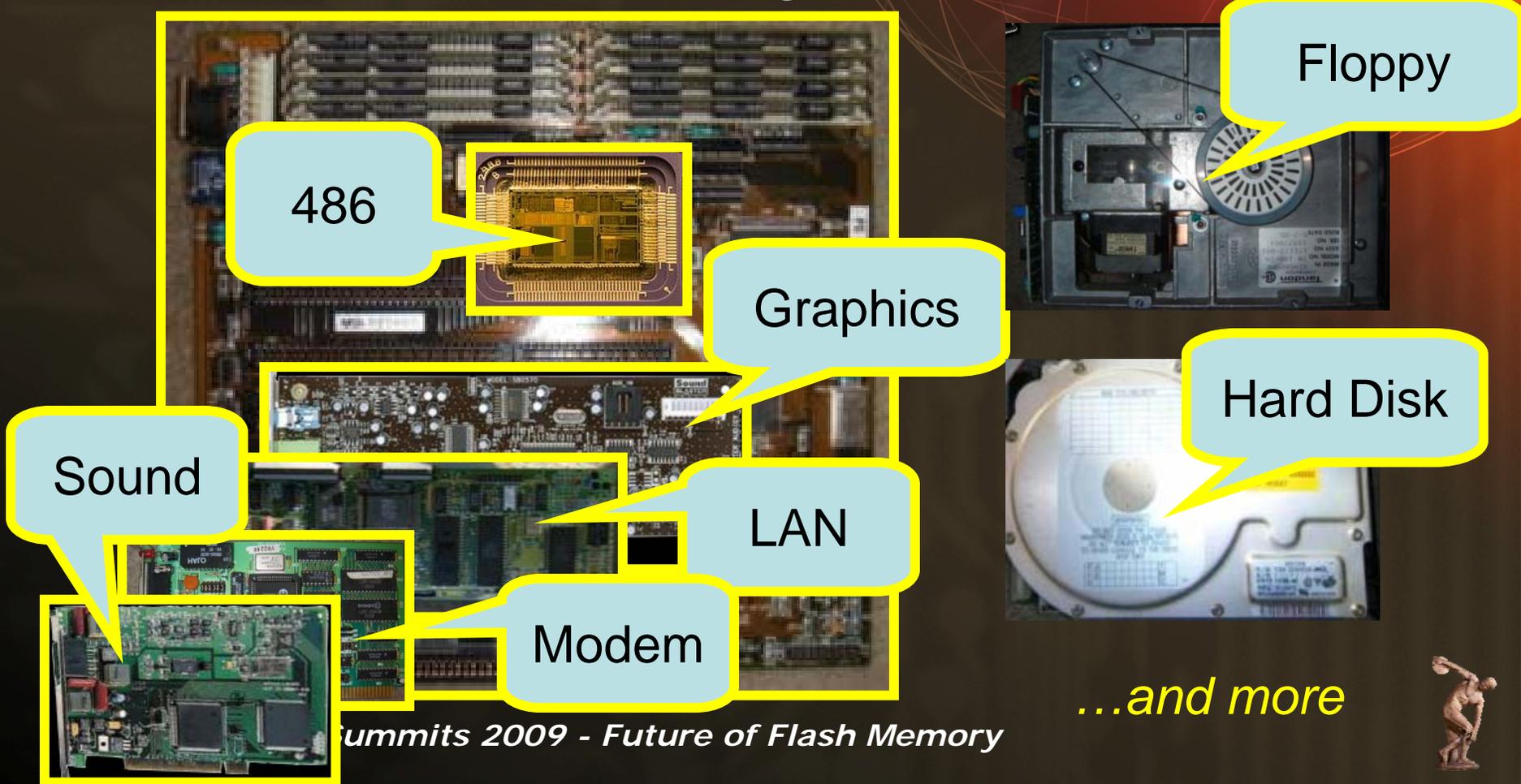




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1990... How Many CPUs in a PC?



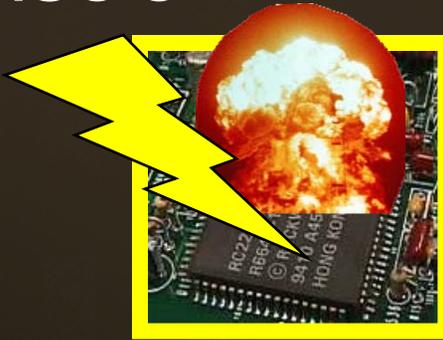
...and more

Summits 2009 - Future of Flash Memory



Native Signal Processing

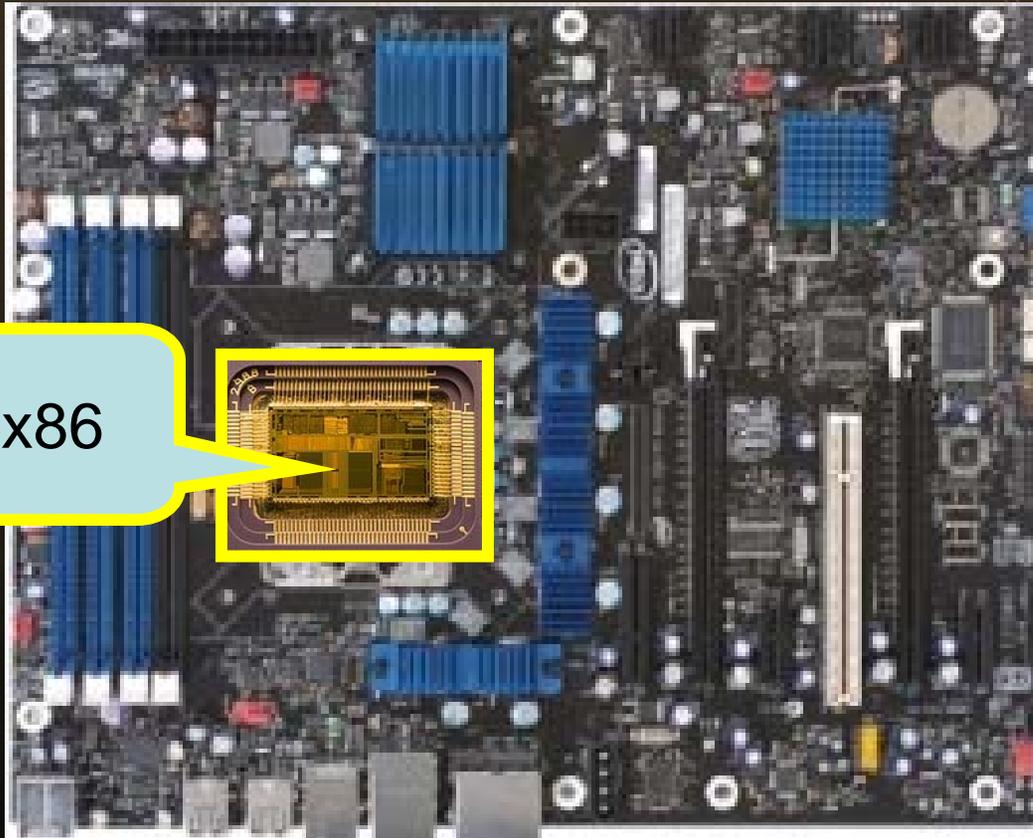
Foreign CPUs represented \$\$ that should be spent on x86's



NSP program initiated to replace foreign CPUs with software



2009: What's Left?



x86



Hard Disk

*...most graphics
now integrated into
north bridge*

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What's Next?

CPU's in the hard disks will be the next victims of NSP

Not worth the pain for rotating media (servo control, etc)...

...But SSD displacing HDD changes the rules of engagement



Flash in the PC

With the price of Flash dropping far below DRAM, it's obvious to add it to the PC

Early attempts at integration were less than successful



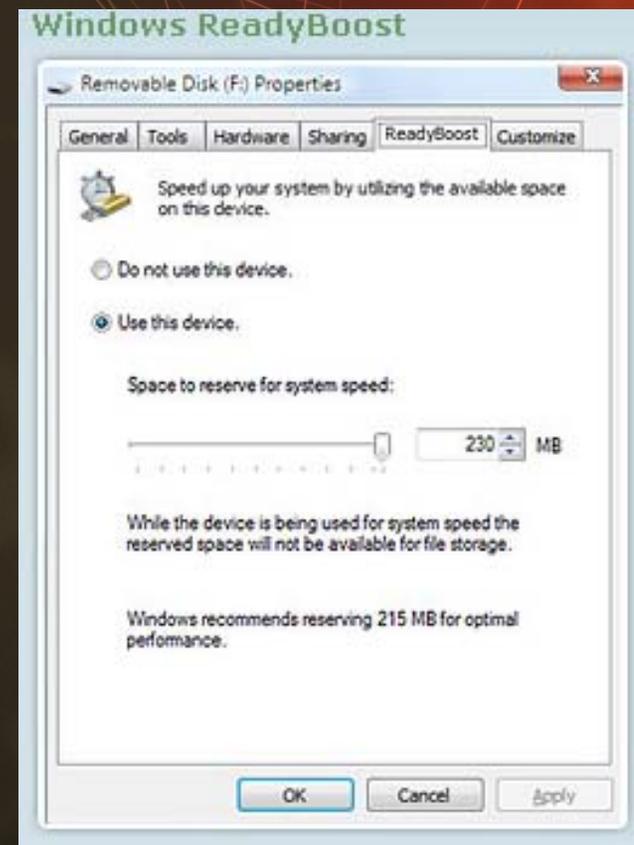
ReadyBoost

Microsoft Vista supports Flash in the PC

Cache for disk

Faster load

Lower power =
battery life



Sounds Good?



"The overall the effect was unnoticeable"

"Installing more RAM inside your PC would help a lot more."



Fragmentation in PC Expansion

**Solid State
Disk?**

**Hybrid
Drive?**

ONFI?

**Express
Card?**

USB?

its 2009 - Futu



SSD = Next Logical Step

As PCs migrate to solid state disk, hard disk form factor makes sense

OEM optionality

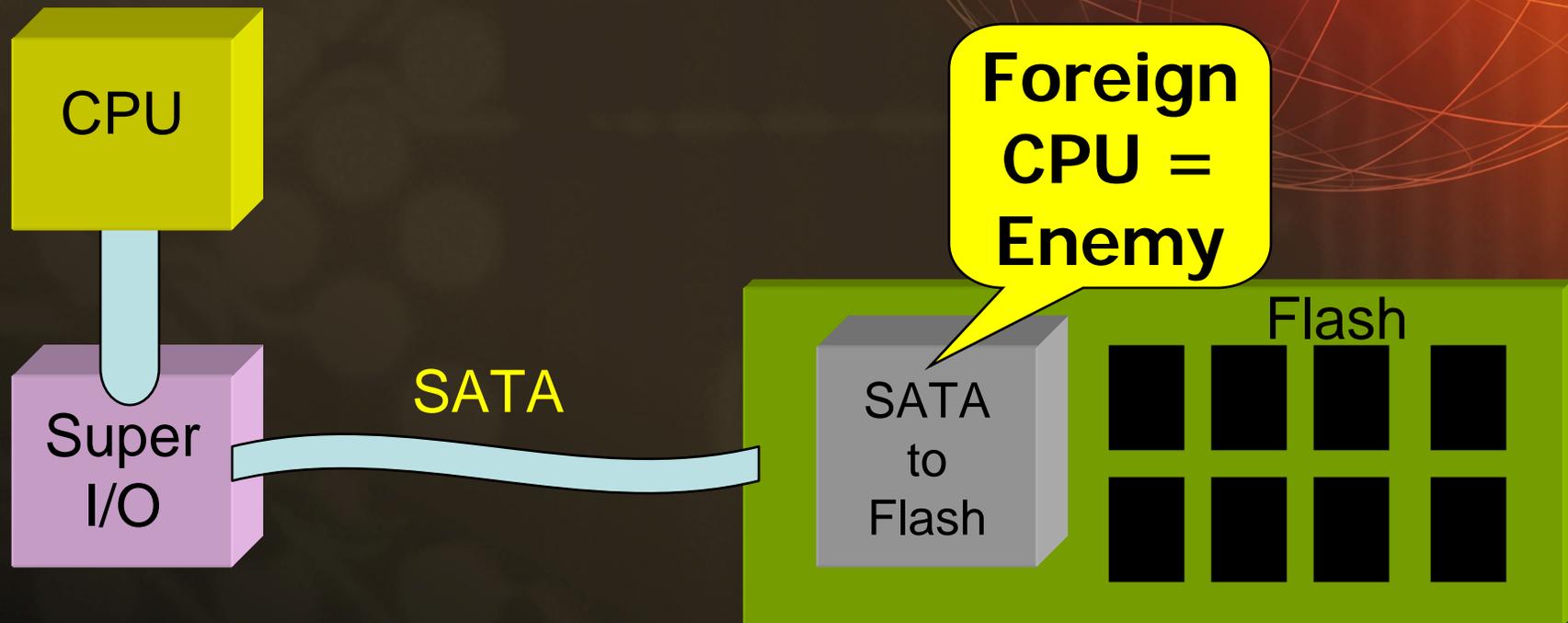
HDD or SSD

GB of Capacity

Upgrade systems



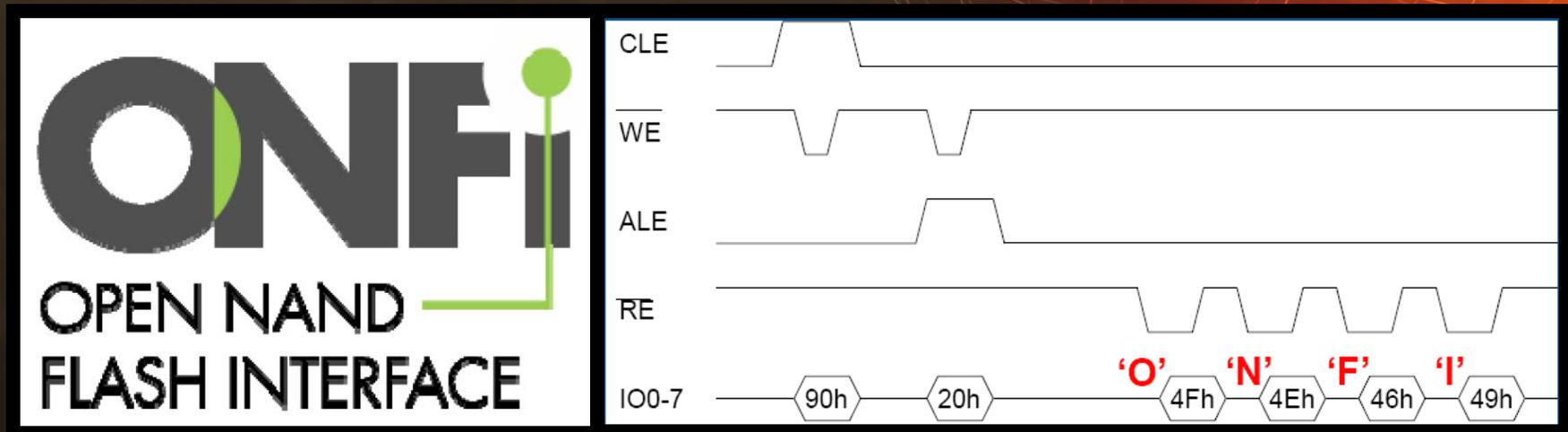
Easy Fitting SSD Into the PC



*...plus ECC, wear leveling,
blah blah blah*



ONFI



Long overdue effort to end the chaos of proprietary flash interfaces



Flash-DIMM = ONFI in the PC

Socket with Flash module
Chipset looks like SATA to the CPU
Uses ONFI to the module



Smaller, lighter, more reliable than SSD

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Replacing SSD In the PC

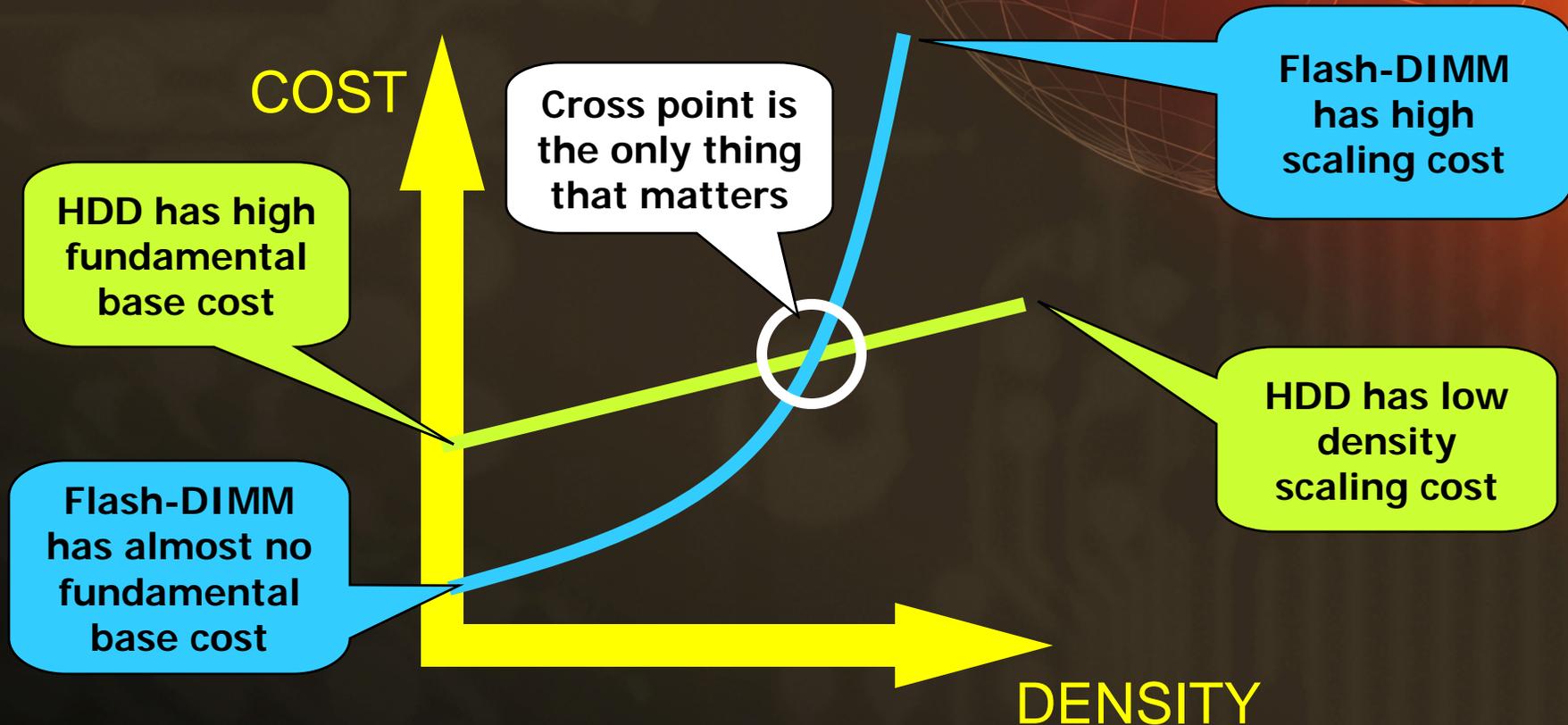


ECC, wear leveling, and blah blah blah becomes just another OS driver

*No intelligence needed down south...
One more foreign CPU killed*



Flash-DIMM Versus HDD Crossover



Flash-DIMM Adoption

HDD → Flash-DIMM crossover

2009 @ 64 GB

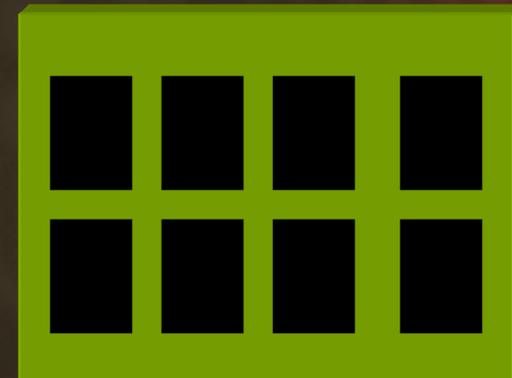
2010 @ 128 GB

2013 @ 1 TB

...etc...

Adoption sequence

1. Corporate notebook
2. Home notebook
3. Corporate desktop
4. Home desktop



More Deadly Details

Corporate NB adoption reduces 2.5" HDD volumes, increasing price...

...Which accelerates adoption in home NB...

...Decreased production of small capacity drives impacts desktop, increasing HDD price...

TB-class hard disks move out of PC

- USB/Firewire
- Network storage
- Cloud storage



The Good News

PC: SSD volumes will increase in the short term... at least 4 or 5 years of good growth

Telecomm: Co-processors are not hated enemies, high IOPs will increase demand for SSD



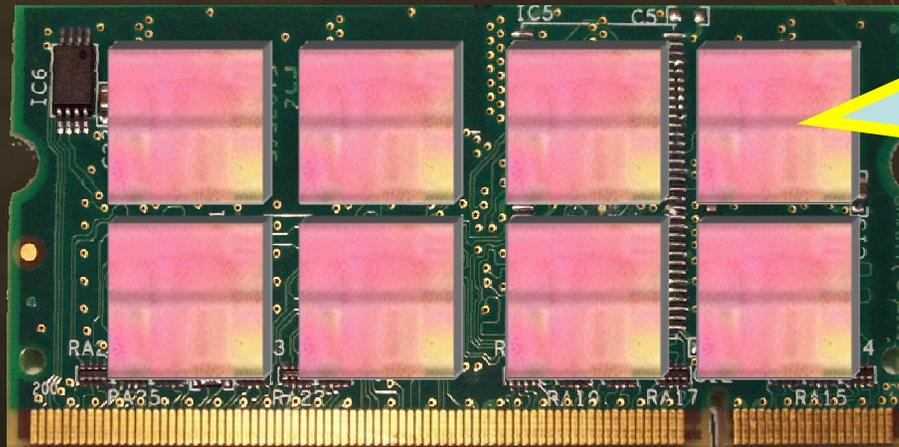
The Bad News

PC: SSD victim of its own success
NSP will absorb SSD into PC

Telecomm: performance had better stay
ahead of an 8-core multi-GHz CPU
because ONFI will be free in these
architectures, too



End Result



Direct Die
Attach of
Known Good
Die to
Reduce Cost

Flash-DIMM is a commodity
Differentiation turns to cost redux
Known good die + direct die attach



Changing Architectures

Adding Flash is just one more step

Multiple levels of memory hierarchy in the works

Operating systems getting smarter

- Volatile versus Non-volatile

- Asymmetrical R/W performance

- Latency differences

Next conference I'll fill you in on the details...

...but imagine 128GB of low latency memory in under 50W





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Thank You

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