

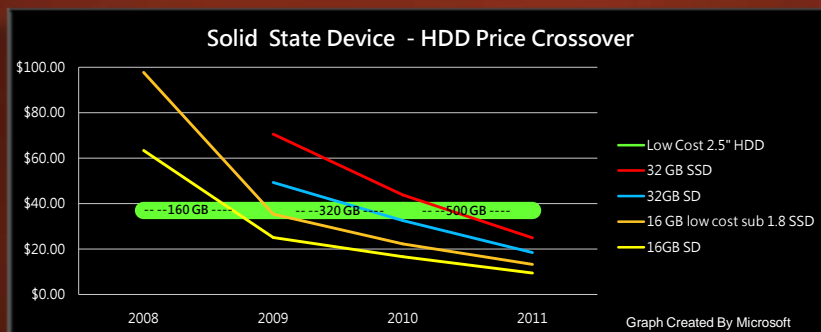
## Windows 7 Disk Footprint

- **Windows 7 disk footprint smaller than Vista**
  - “Installed footprint” includes logs, memory dumps, caches, restore points, pagefile, hiberfil
  - Balance: Managing growth while providing new features
- **Windows 7 will run well on 16GB systems**
  - ~50% of drive used by Windows over life of PC
    - Daily use, including growth and footprint per above
  - ~50% of drive available
    - Applications
    - Media storage
    - Working space for installs

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## Why Flash Storage For Netbooks?

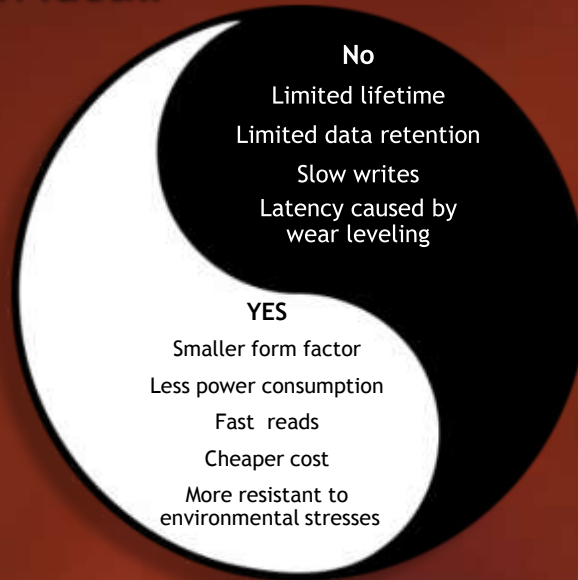
- Non-volatile memory is an excellent fit for Netbooks
- Resistant to shock, dust, temperature, humidity, lower power, small form factor
- Lower cost for low-end devices



Source: Market Statistics: History, Market Share and Forecast, HDDs, Worldwide, 2003-2012, Gartner June 2008, John Monroe  
Semiconductor Forecast Worldwide--Forecast Database [SEQS-VW-DB-DATA], Gartner August 2008, Joe Unsworth

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## Is Flash Ideal?



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## NAND Flash Performance And Endurance

### NAND Flash

Single Level Cell (SLC)

Multi Level Cell (MLC)

- Limited lifetime
- More bits per cell = shorter lifetime
- Design for expected lifetime and best Windows 7 experience

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## In An Ideal World...



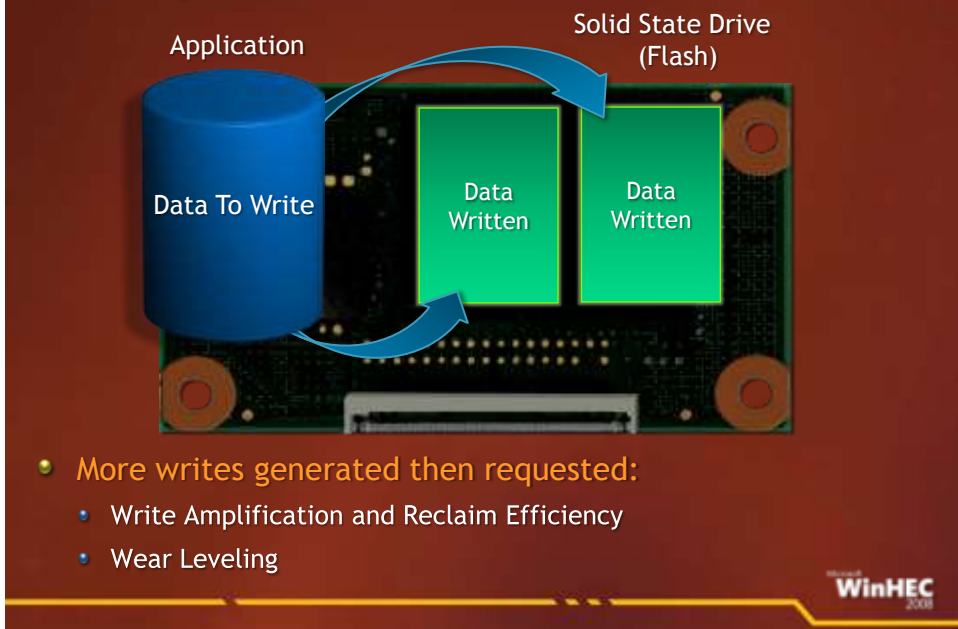
10,000 Erase Cycles  
x 16 GB storage  

---

160,000 GB Write Capability

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## Reality Of Flash



Application

Data To Write

Solid State Drive (Flash)

Data Written

Data Written

- More writes generated than requested:
  - Write Amplification and Reclaim Efficiency
  - Wear Leveling

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# video

Reclaim Efficiency

**Bohdan Raciborski**  
Principal Software Architect  
Microsoft Corporation



## Wear Leveling



Attempt to wear all blocks evenly



# Flash Storage Lifetime

Lifetime is increased by better hardware and larger storage



Life (Year)

=

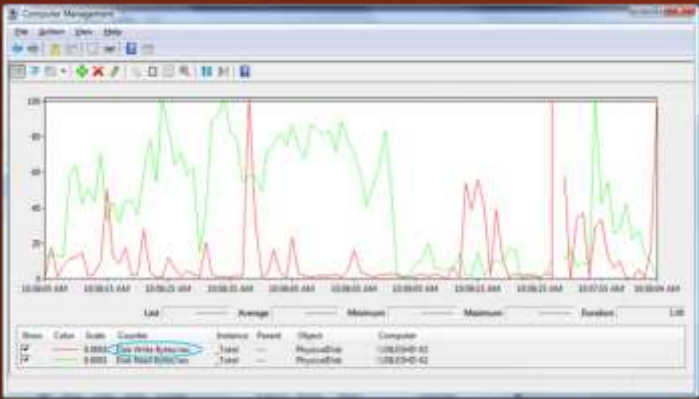
Actual Write Capacity (GB)

Write Rate (GB/Year)



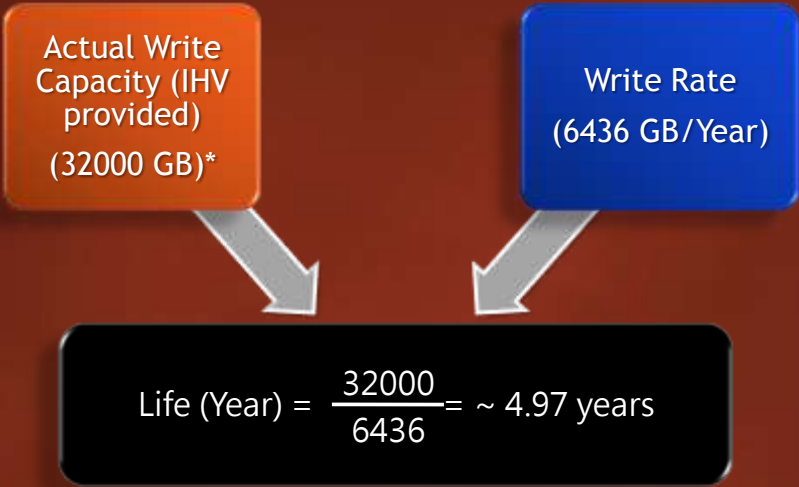
Lifetime is increased by smaller workloads

# Calculating Write Rate

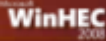


- Our test: Write rate from 10 people over 4 weeks
- Write Rate (95% population) = 6.5 TB per year

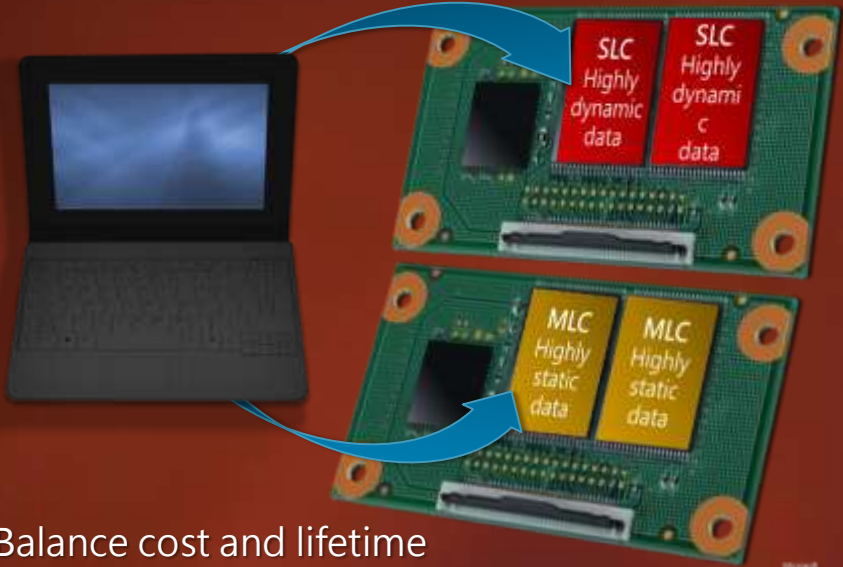
# Example



\*Collaborate with IHV to obtain Actual Write Capacity.  
32000 GB is an example used to demonstrate a concept



# Using Multiple Flash Types



# Other Storage Considerations

## Storage Mounting

### Discrete Components

Controller & Flash are separate modules

### Self Contained

Controller & Flash are contained in a single module

## Housing

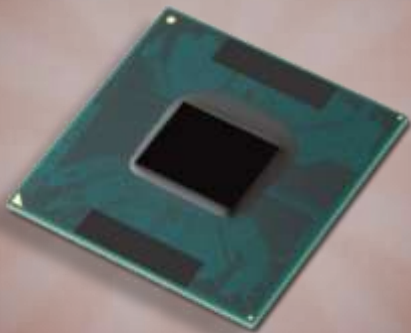
### Internal Mounting

Removable media is mounted inside casing

	ATA	USB (not supported)
Crash dump	✓	✗
Page file	✓	✗
Hibernation file	✓	✗

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# CPU Considerations



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# Performance

## I/O balancing speed consideration

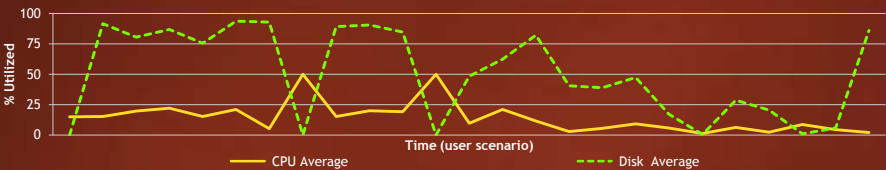
- Random I/O speed affects Windows experience
- Faster I/O speed equals faster boot time
- Ask your SSD IHV for random speed

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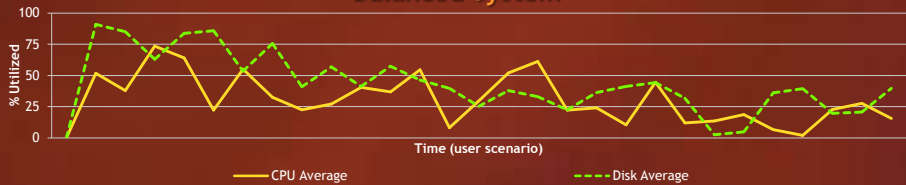
# Performance

## CPU and I/O balancing

Unbalanced System



Balanced System



Target: CPU utilization & Disk I/O balance

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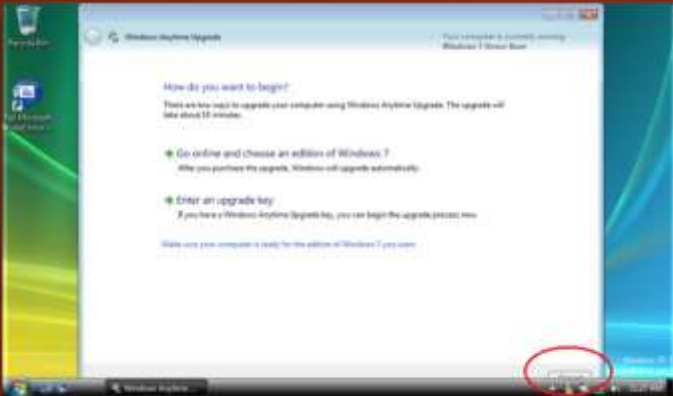
# Screen Considerations



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# Screen Considerations

Don' t let this happen to you!



Ensure applications meet minimum  
resolution requirements

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## Our Commitment

- **We are committed to help netbook manufacturers offer best products**
- **We provide:**
  - Technologies to optimize Windows 7 for flash storage
  - Guidance: Flash PC design guide
  - OPK tools

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## Windows 7 Flash Technologies

- **Non spinning disk (SSD) detection**
  - No scheduled defrag
- **Trim command**
  - OS will notify device when file is deleted
  - Better wear leveling and early garbage collection
- **Partition alignment to reduce writes**
- **Logo requirements for SSD performance**

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## Flashed Based Netbook Design Guide

- Not a Reference Design
- Helps reduce development costs and time to market
- Offers guidance on how to build for best Windows experience

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## Call To Action

- Use Design Guide to optimize your Netbook for Windows experience
- Estimate the endurance of your Netbook, ask your SSD IHV for help
- IHVs: collaborate on the standard way to measure SSD endurance

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## Additional Resources

### Related Sessions

- COR-T558 “Windows 7 Enhancements for Solid-State Drives”
- ENT-T539 “Design Tradeoffs for Solid-State Disk Performance”
- COR-T559 “System Integrated Flash Storage”

### Web Resources

- Design Tradeoffs for SSD Performance:  
<http://research.microsoft.com/users/vijayanp/papers/ssd-usenix08.pdf>

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