The Next Killer App for Flash: The PC – Caches and SSDs

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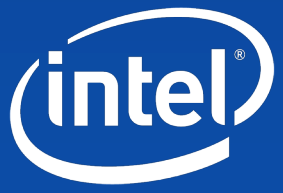
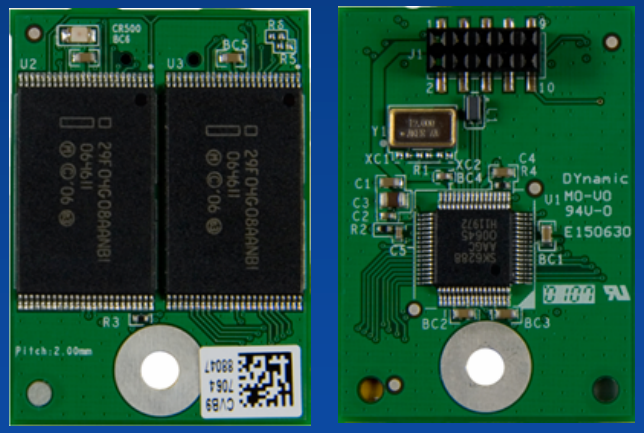
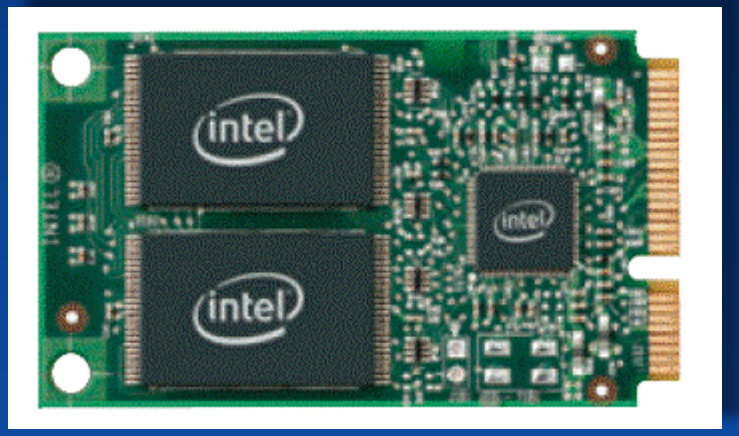


2007 is the Start of NAND Entering the PC Platform

- NAND has started penetrating the PC
  - PCIe-based modules, like Intel® Turbo Memory
  - SSD solutions, like Intel® Z-U130 Value SSD



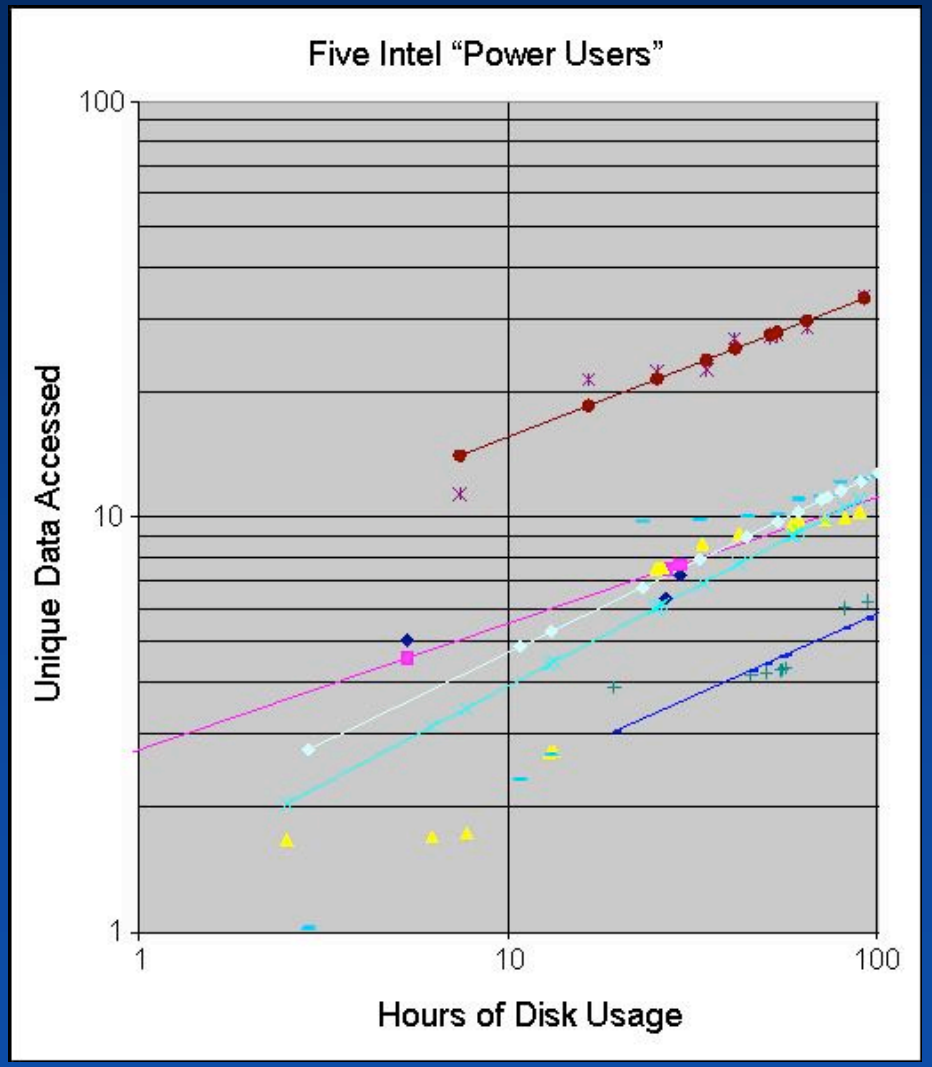
Intel® Z-U130 Value SSD

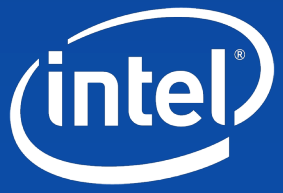


Intel® Turbo Memory

User Working Set Sizes are Small, Enabling Big Flash Benefit

- Working set sizes are small
- Eg: Five Intel “power users” traced their system usage
  - Only one user accessed more than 6 GB in 10 hours of work
- With larger caches and intelligent heuristics, there are huge benefits
  - The disk becomes just a backup store for less often used files





NVMHCI Standard: Key Enabler of PC Growth

- The Non-Volatile Memory Host Controller Interface (NVMHCI) defines the programming interface to a platform NAND device
- Platform NAND may appear as a “port” under the SATA AHCI controller
  - Enables a single storage driver to manage SATA and NAND
- 0.70 revision delivered, publication end of year

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Dell, Intel and Microsoft Join Forces to Increase Adoption of NAND-Based Flash Memory in PC Platforms

Newly formed group to provide standard interface for nonvolatile memory subsystems.

REDMOND, Wash. — May 30, 2007 — Broad adoption of NAND flash memory technology in the PC platform received a boost with the formation of the Non-Volatile Memory Host Controller Interface (NVMHCI) Working Group. The NVMHCI Working Group is chaired by Intel Corporation with core contributors including Dell Inc. and Microsoft Corp.

Related Links
External Resources:
- Dell Web site
- Intel Web site

NVMHCI will provide a standard software programming interface for nonvolatile memory subsystems. The interface would be used by operating system drivers to access NAND flash memory storage in applications such as hard drive caching and solid-state drives.

“Several NAND solutions are coming on the scene to take advantage of the ReadyBoost™ and ReadyDrive™ features of the Windows Vista® operating system,” said Bob Rinne, general manager of Windows Hardware Ecosystem at Microsoft. “Standardizing on a common controller interface will enable more integrated operating system support of these solutions moving forward.”

Industry momentum for standardization in NAND storage solutions is building, especially as NAND moves into the PC platform. NVMHCI complements standardization work being done in the Open NAND Flash Interface (ONFI) Working Group.

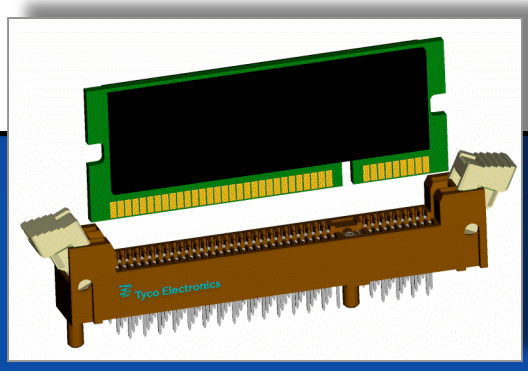
“We’ve got a performance-enhancing NAND-based product in the market with our new Centrino mobile technology platform called Intel Turbo memory, and this newly formed working group will help make that and a number of other NAND-based solutions more prolific, faster,” said Rick Coulson, senior fellow and director of I/O Architecture at Intel. “ONFI formed last year to standardize the interface between the Flash controller and the NAND itself, and standardizing the register level interface between the Flash controller and the operating system driver is the logical next step.”

“Nonvolatile memory solutions enable better system performance and lower power consumption as well as facilitate additional benefits such as smaller form factors, quieter
mmunications for technology
industry partners and
ustry-leading companies

NVMHCI Enables Baseline OS Driver Support for NAND

ONFI Standard: Key Enabler of PC Growth

- ONFI defines baseline Flash command set, timings, and protocol
  - Feature identification mechanism enables new NAND modules to be used effectively in PC applications
- ONFI defines standard connectors, enabling Flash to be used like a DIMM
- ONFI is delivering a much higher speed DDR Flash interface protocol
  - Delivers significant performance gains for PC applications



PC Market Segment Opportunity

- The PC TAM for 2009 is:
  - Notebooks: 137 Million units*
  - Desktops: 162 Million units*
- IDC predicts that in 2009 there will be 85 Million units* of NAND caches sold, at 512 MB per unit
  - Less than 30% attach with small size… We can do better.
- The imperative is to unlock the value in 8 GB caches that captures the user's working set for the whole day
  - Leads to more NAND cache units sold at much higher capacity

Caches that Capture Entire Working Set Key to Explosive Growth for PC Market Segment!

* Source: IDC