Solid-State Drive (SSD)
Future Architectures

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Agenda

- Why SSD?
- Storage Evolution
- Enhance the SSD Capacity
- Enhance the SSD Latency
- Conclusions
Will SSD increase your PC computing performance?

Should we expect for higher performance?
Trends in storage #1: archiving

More storage space is required!

Source: UC Berkeley, School of Information Management and Systems.
Trends in storage #2: mobile software code storage

More performance is required!
Trends in storage #3: Server database access

More storage space and performance are required!
Storage Evolution

Today

processor

Memory controller

nS

DRAM

IO controller

mS

Magnetic Disk

Keyboard, mouse etc.
Storage Evolution

➢ Today

- processor
- Memory controller
- IO controller
- DRAM
- Magnetic Disk + SSD buffer
- Keyboard, mouse etc.

Today

nS

Improved

mS
Storage Evolution

- high-end

processor

Memory controller

nS

DRAM

IO controller

uS

Keyboard, mouse etc.

Magnetic Disk + SSD buffer
Storage Evolution

Future

processor + memory controller

IO controller

Keyboard, mouse etc.

nS

DRAM

uS

SSD
Storage Evolution

Future

processor + memory controller

Improved nS

IO controller

SSD

Keyboard, mouse etc.

DRAM
Each device has inherent storage limitations

Flash stores analog signal

We need HDD $/GB + SSD Performance…

Explore the architecture!
Storage drive architecture

Proper architecture: push the device to its limits
Voltage window budget allows one bit per cell (1BPC)
Flash Memory - Multi Level Cell (MLC)

- Large window budget and complex design = more BPC

$/GB depends on the architecture
Enhance SSD latency

Use heterogeneous solid state storage and dynamically switch between SLC and MLC
Future solid state drive faces two major challenges:
- Capacity and $/GB ratio
- Latency

Use of dynamically configured SLC/MLC and DRAM/NOR devices in SSD improves the latency, but the media protocol is the real latency bottleneck.
PC Computer System

- CPU
- Memory Controller
- FSB
- Memory bus
- RAM
- Graphics Controller
- AGP / PCIe
- PCI bus
- I/O Controller
- PCI bus
- SATA
- IDE, USB, Ethernet, VGA, SD
- LPC bus
- Flash BIOS
- Super I/O
- I/O Devices
- Graphics
- PCI
- PCI bus
Questions?

High Density
Low $/MB

ROM
EPROM

DRAM
SRAM

FLASH

Nonvolatile

EEPROM

Updateable