Market Segments by Applications

- **Transaction Processing**
- **eCommerce**
- **Data Warehousing**
- **Business Intelligence**
- **Visual DB**
- **Scientific Computing**
- **Imaging**
- **Audio**
- **Video**
- **Web 2.0**
- **HPC**
- **TP**

*IOs per second for a required response time (ms)

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Corporate Data Usage

I/O Access Frequency vs. Percent of Corporate Data

- **Cache**
  - SSD
  - Logs
  - Journals
  - Temp Tables
  - Hot Tables

- **Disk Arrays**
  - Tables
  - Indices
  - Hot Data

- **Tape Libraries**
  - Back Up Data
  - Archived Data
  - Offsite DataVault

% of Corporate Data vs. % of I/O Accesses
Corporate Cloud Storage Usage

I/O Access Frequency vs. Percent of Corporate Data

- SSD
  - Logs
  - Journals
  - Temp Tables
  - Hot Tables

- SAS/FCoE Arrays
  - Tables
  - Indices
  - Hot Data

- Cloud Storage
  - SATA
    - Back Up Data
    - Archived Data
    - Offsite DataVault

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Rise of DB-in-Memory for BI / DataWarehousing

Scale In

Large DB Size Growth by Market Segment

Storage Usage vs DB Capacity

Corporate Data Usage
I/O Access Frequency vs. Percent of Data

Virtual Tape Libraries
- Back Up Data
- Archived Data
- Offsite DataVault
HPC: Academia > BioMed > Wall St > Hollywood

Earth Resources
Oil & Gas …

Commercial Visualization

Bioinformatics & Diagnostics

Decision Support
- Hedge Funds …

Entertainment-
VoD / U-Tube

➢ 100+ Teraflops
➢ Throughput : 100 GB/s

➢ Rendering (Texture & Polygons)
➢ Throughput : 1.2 GB/s

➢ Data rate & capacity
➢ Throughput : DSL/Cable

Data: IMEX Research & Panasas
Computing Dynamics – Memory Impact

- Cloud Computing
- Virtualization
- Power Efficiency
- Multicore
- Blades
- HPC Clusters
- Consumer Electronics - Visualization
- 64 bit Computing

<table>
<thead>
<tr>
<th>Year</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
</table>

- Memory Impact
  - Hi Cap SSD/SATA
  - VMs Memory Intensive
  - New Techniques (Qiminda)
  - 2-4GB Memory/Core
  - Solid State Memory
  - DRAM Capacity
  - NAND Flash Capacity
  - Lg. Addressable Space
Blade Servers – On a Fast Growth path

Scale In

Scale Out

Scale Up

Network:
- IP NAS, FC SAN
- Midplan e
- Climate
- Power Supplies
- Storage: IP NAS, FC SAN
- Management Modules

Processor Blades

Memory DDR3 w ECC

Networking:
- Gbit Ethernet I/F

Major Players:
- HP
- IBM
- Fujitsu
- Cisco Systems
- Dell
- Sun Microsystems
- Intel
- Unisys
- Motorola
- NEC

WW Blade Servers Market (cum 2008-12)

Rev ~ 43 Billion Units ~ 19 Million

Factory Rev $F

$12

$10

$8

$6

$4

$2

$0

2008 2009 2010 2011 2012

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NAND: Enabling Consumer to Enterprise Mkts

Cost Decreasing
~50% / GB / Year

Density Increasing
2X per Year

SSD
64-300 GB

NAND Fueling New Applications...

DSC Card
32MB ~ 4GB

USB Drive
64MB ~ 4GB

MP3 Player
512MB ~ 8GB

Cell Phone
512MB ~ 8GB

Source: Samsung & IMEX Research

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Flash in Enterprise Storage Systems

Anil Vasudeva
President & Chief Analyst
imex@imexresearch.com
408-268-0800