Accelerating I/O-Intensive Applications in IT Infrastructure with Innodisk FlexiArray™ Flash Appliance

Alex Ho, Product Manager
Innodisk Corporation

** Information in this presentation is provided on an ‘as is’ basis and subject to change without prior notice.**
Outline

• Innodisk Introduction
• Industry Trend & Challenge
• Innodisk FlexiRemap™ Technology
• Innodisk FlexiArray™ Product
• Calls to Action
Innodisk Overview

• About Innodisk Corporation
  – Founded in 2005 in Taiwan
  – Got Initial Public Offerings in 2013
  – Employees (Global): 400, Headquartered in Taipei
  – Leader in industrial memory and storage products
  – Capabilities and experiences in firmware & software development for flash memory management
  – Dedication to providing absolute service
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INDUSTRY TREND AND CHALLENGE
IT Growth Trend: PC → Mobile → IOT

Source: KPCB, Cisco

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Mobile Data Traffic Growth

2018:
Billions of Devices
190 EB

Faster Speed

More Users

More Videos

More Connections

Global Mobile Data Traffic Forecast, 2013–2018

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By Moore’s law, CPU improves 100 times every decade, while drive performance remains flat.

Applications will increasingly suffer unless moving to flash.

**InnDisk**

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The Challenges

• Performance of Storage Access
  – Performance hit for random write operations
  – Performance varies quite a bit along with time and space of use

• Data Endurance and Protection
  – Relatively limited lifespan of flash cells
  – Data loss upon drive failure

• Cost Effectiveness
  – Solutions based on specialized hardware designs are not affordable
to a wide variety of market segments with such demands
Our Solution – FlexiRemap Technology

• About Innodisk FlexiRemap™ Technology
  – Manages flash memory with software running in kernel level of OS
  – Aggregates multiple SSDs into a super drive to deliver high IOPS even for random writes
  – Incorporates a collaborative architecture for drivers and firmware to work together
  – Runs on standard commodity off-the-shelf (COTS) platforms, without need for special hardware
Storage for Cloud Computing

Applications
- Enterprise virtualization
- High volume databases
- Multimedia production
- Caching and tiering etc.

- High performance
- Low latency

Nanoseconds (ns) — Access Latency — Milliseconds (ms)

Innodisk FlexiArray™
Different Ways to Build Flash Array

High performance through direct control over flash memory

**Approach I**
Design from scratch and build flash array with proprietary hardware and software components
- tends to be expensive

**Approach II**
Leverage standard server platforms and create custom software to accommodate SSD behaviors
- hits limitations imposed by SSDs

Cost-effective, more affordable

**Approach III:**
Innodisk FlexiRemap™
Innovations in software and firmware, running on commodity off-the-shelf (COTS) platforms

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OUR SOLUTION: INNODISK FLEXIREMAP™ TECHNOLOGY
Innodisk FlexiRemap™ Technology

- Innodisk FlexiRemap™ Technology Features:
  - An adaptive FTL implemented at OS kernel level
  - Flexible aggregation of multiple SSDs into a super drive
  - Smart rescheduling of random write operations into sequential ones
  - Global wear leveling with inter-drive knowledge
System Architecture

- **PCIe**: Host Processor (x64), Host Chipset, SAS/SATA
- **NVMe SSD**: RAID Ctrl., NVMe SoC (ARM Core)
- **FlexiRemap™ Manager**
- **FlexiRemap™ Library**
- **Adaptive Remapper**
- **Storage Driver**
- **Collaborator**
- **Firmware**
- **Controller/SoC**
- **Host Processor/Chipset**

- Application Software
- Middleware/User-Mode Subsystem
- Operating System Kernel
- Hardware Platform

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Direct Control over Flash Memory

**Table:**

<table>
<thead>
<tr>
<th>Channel 0</th>
<th>Channel 7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Block 0</strong></td>
<td><strong>Block 8</strong></td>
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<tr>
<td>Page 0</td>
<td>Page 0</td>
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<tr>
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<td>2</td>
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<td>Page 255</td>
<td>Page 255</td>
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<tr>
<td>2 5 5 5</td>
<td>2 5 5 5</td>
</tr>
</tbody>
</table>

**Logical Unit:**

- **Plane 0**
- **Plane 1**

**Chip Enable Pins:**

- Chip Enable Pin 0
- Chip Enable Pin 1
- Chip Enable Pin 2
- Chip Enable Pin 3

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Scalable Performance

• Projected IOPS with Innodisk SATA III SSDs
  – 8 x SSDs: 280K+ IOPS for random write
  – 16 x SSDs: 650K+ IOPS for random write
  – 24 x SSDs: 1M+ IOPS for random write

Performance of 4 KB Random Write Operations

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Differentiation

- Highest Possible Performance under Same Architecture
  - From **flash-compatible** to **flash-collaborative**
  - Achieving sustained high IOPS through close collaboration between upper-layer **software** and underlying **firmware**
  - Built upon commodity off-the-shelf (COTS) platforms and components, without need for custom-made, expensive hardware
Productization Possibilities

- Products Powered by FlexiRemap™ Technology
  - High-performance storage appliance
    - Flexible disk array, with sustained high IOPS
    - Expandable, up to 24 x 2.5" SSDs
  - Acceleration board for I/O-bound applications
    - No change to existing applications
    - Plug and play, intuitive configuration
  - Performance optimization software suite
    - Boosting performance of SSDs
    - Transparent to application software

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## FlexiArray™ Storage Appliance

<table>
<thead>
<tr>
<th></th>
<th>FlexiArray™ SE108</th>
<th>FlexiArray™ SE110</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Configuration</strong></td>
<td>1 TB</td>
<td>3 TB</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td><strong>Sustained</strong></td>
<td><strong>Sustained</strong></td>
</tr>
<tr>
<td>(4 KB Random Write)</td>
<td><strong>285,000 IOPS</strong></td>
<td><strong>320,000 IOPS</strong></td>
</tr>
<tr>
<td><strong>Flash Type</strong></td>
<td>MLC</td>
<td>MLC</td>
</tr>
<tr>
<td><strong>Connectivity</strong></td>
<td>4 x 10GbE SFP+ or</td>
<td>4 x 10GbE SFP+ or</td>
</tr>
<tr>
<td></td>
<td>1 x InfiniBand FDR</td>
<td>1 x InfiniBand FDR</td>
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<tr>
<td></td>
<td>QSFP</td>
<td>QSFP</td>
</tr>
<tr>
<td><strong>Protocols Supported</strong></td>
<td>iSCSI, NFS, CIFS</td>
<td>iSCSI, NFS, CIFS</td>
</tr>
<tr>
<td><strong>Form Factor</strong></td>
<td>1U Rack Mount</td>
<td>1U Rack Mount</td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td>Max. 750 W</td>
<td>Max. 750 W</td>
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Calls to Action

• Go to [http://flexiarray.innodisk.com/](http://flexiarray.innodisk.com/) for additional information

• Send your inquiries to [cloudsolution@innodisk.com](mailto:cloudsolution@innodisk.com)
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Innodisk Corporation | 宜鼎國際股份有限公司

設計 | 服務 | 品質 | 交期
Design | Service | Quality | Delivery

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