TOMORROW starts here.
Cisco UCS INVICTA Solid State Solutions

BRKDCT-1234

Darren Williams
SE Manager EMEAR Business Group
Disk Performance Fundamentals

HDDs Aren’t Designed For High Performance

Compute in nanoseconds

Write/Read Data in milliseconds

Transistors

2012

1956

RPM
Disk Performance Fundamentals

The Trade Offs

With HDDs you’re always trading performance for protection or vice versa.
Disk Performance Fundamentals

The Trade-offs Produce Complex Inefficient Storage Configurations

1,000 Persistent Desktops will require:
< 10TB of capacity
~80K backend IOPS

TOTAL IOPS: 114,950
TOTAL CAPACITY: 63.2 TB

Reference Architecture for 1,000 Desktops

3 types of drives, 3 types of RAID

- 41 15K HDDs
- 25 7.2K HDDs
- 3 Flash Drives

< 10TB of capacity
~80K backend IOPS

TOTAL IOPS: 114,950
TOTAL CAPACITY: 63.2 TB
## Disk Performance Fundamentals

Flash is designed to deliver higher performance & lower operating costs.

### Performance Comparison

<table>
<thead>
<tr>
<th>Speed</th>
<th>Latency in Seconds</th>
<th>Transfer rate(s) MB/s</th>
<th>Write /Read operations per Second (IOPS)</th>
<th>Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Disk Drive (HDD)</td>
<td>0.001 (milliseconds)</td>
<td>10s</td>
<td>100s</td>
<td>Mechanical</td>
</tr>
<tr>
<td>Flash Drive (Flash)</td>
<td>0.000001 (microseconds)</td>
<td>100s</td>
<td>1000s</td>
<td>Silicon</td>
</tr>
</tbody>
</table>

- **Latency**: HDD < Flash
- **Transfer Rate**: HDD < Flash
- **IOPS**: HDD < Flash

### Design

- **Mechanical**
  - Motors & Spindles
- **Silicon**
  - Integrated Circuit

### Energy Consumption

- **High Energy Consumption**: HDD
- **Low Energy Consumption**: Flash

### History

- **Low Performance**: Est 1956 - HDD
- **High Performance**: Est 1980 - Flash

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Cisco Public
## NAND Flash Fundamentals

### Different Type of NAND Flash

<table>
<thead>
<tr>
<th>States</th>
<th>Erase Cycles</th>
<th>Max (^t\text{Prog})</th>
<th>(^t\text{R})</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLC</td>
<td>2</td>
<td>100,000</td>
<td>700us</td>
<td>$$$</td>
</tr>
<tr>
<td>MLC</td>
<td>4</td>
<td>3,000-10,000</td>
<td>1200us</td>
<td>$$</td>
</tr>
<tr>
<td>TLC</td>
<td>8</td>
<td>1,000</td>
<td>2000us</td>
<td>$</td>
</tr>
</tbody>
</table>

\(^t\text{Prog}\) – Time to transfer contents of data register to flash

\(^t\text{R}\) – Time to transfer contents of 1 flash page to data register
# NAND Flash Fundamentals

## Implementations of Flash

<table>
<thead>
<tr>
<th>High Performance Array</th>
<th>High Capacity Array</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Optimized to sustain High Write and Read throughput</td>
<td>• Virtually extends storage capacity of NAND Flash via system-wide compression and de-duplication</td>
</tr>
<tr>
<td>• High bandwidth and IOPS. Low latency.</td>
<td>• Mutes NAND Flash performance with system-wide compression and de-duplication</td>
</tr>
<tr>
<td>• Multi-protocol</td>
<td>• RAID Protection</td>
</tr>
<tr>
<td>• LUN Tunable performance</td>
<td></td>
</tr>
<tr>
<td>• Software designed to enhance lower cost NAND MLC Flash by optimizing High Write throughput while substantially reducing wear.</td>
<td></td>
</tr>
<tr>
<td>• RAID Protection and replication</td>
<td></td>
</tr>
</tbody>
</table>

## Storage options

<table>
<thead>
<tr>
<th>PCI Express Card</th>
<th>Hybrid Array (HDD &amp; SSD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Very Expensive</td>
<td>• Compromise between capacity and performance</td>
</tr>
<tr>
<td>• RAID protection is expensive</td>
<td>• Lower performance than 100% SSD</td>
</tr>
<tr>
<td>• Requires specialized drivers</td>
<td>• Compromised durability with HDD</td>
</tr>
<tr>
<td>• Locked in the server, difficult to share and service</td>
<td>• Higher energy costs with HDD</td>
</tr>
<tr>
<td>• Not a data center storage resource</td>
<td>• RAID Protection</td>
</tr>
</tbody>
</table>
NAND Flash Fundamentals
Simplify. Accelerate. Scale.

### INVICTA LUN Diagram

#### Nodes, Media, Size, IOPS, Capacity

<table>
<thead>
<tr>
<th>Nodes</th>
<th>Media</th>
<th>Size</th>
<th>IOPS</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Flash</td>
<td>3TB Raw/30 TB effective</td>
<td>825,000</td>
<td>150 TB</td>
</tr>
</tbody>
</table>

#### Data Reduction Nodes for 1000 Desktops

- 250 Users Per node
- Infrastructure
  - Virtual Desktops
  - Snapshots

- Data Reduction Nodes for 1000 Desktops
NAND Flash Fundamentals
Make Life Easier with Flash

41 15K HDDs
25 7.2K HDDs
3 Flash Drives

114,950 IOPS  63.2 TB

200,000 IOPS  64 TB
NAND Flash Fundamentals
Make Life Easier with Flash

- 41 15K HDDs
- 25 7.2K HDDs
- 3 Flash Drives

114,950 IOPS, 141TB vs. 825,000 IOPS, 150TB
Cisco UCS INVICTA Series
Product Overview
Cisco Unified Computing System

UCS Founding Principles

Application Centricity  Operational Simplicity  Platform for IT Innovation
Introducing the Cisco UCS Invicta Series

UCS Founding Principles
- Application Centricity
- Operational Simplicity
- Platform for IT Innovation

UCS Invicta Series Solid-State Systems
- Address new data velocity and scale requirements
- Integrate application acceleration into the computing domain

NEXT GEN UNIFIED COMPUTING
Integration of Solid-State Memory Systems into the UCS Fabric
Introducing the Cisco UCS Invicta Series

UCS Invicta Scaling System

First release:
Up to 1.3 Million IOPS
Up to 13.2 GB/s Bandwidth
Up to 240 TB RAW

Using Invicta OS 5.0.0

UCS Invicta Appliance

First release:
250,000 IOPS
1.9 GB/s Bandwidth
Up to 24 TB RAW

✓ Scalability
✓ Modularity
✓ Application Acceleration
✓ Data Optimization
✓ Multiple Workloads
✓ Tuning-Free Performance

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# Cisco UCS INVICTA Series

Building Blocks To Accelerate & Optimize Data

<table>
<thead>
<tr>
<th>Workload Acceleration</th>
<th>Data Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Appliance</strong></td>
<td><strong>Silicon Node</strong></td>
</tr>
<tr>
<td>Bandwidth (GB/s)</td>
<td>1.9</td>
</tr>
<tr>
<td>IOPS</td>
<td>250,000</td>
</tr>
<tr>
<td>Latency (Microseconds)</td>
<td>&lt;100</td>
</tr>
<tr>
<td>Size</td>
<td>2 RU</td>
</tr>
<tr>
<td>Max Capacity (TB)</td>
<td>24</td>
</tr>
</tbody>
</table>

* Effective Capacity
# Cisco UCS INVICTA Series

## Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Appliance</th>
<th>Scale Up</th>
<th>Scale out</th>
<th>Architecture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INVICTA OS</strong></td>
<td>5.0 and up</td>
<td>5.0</td>
<td>5.1.0</td>
<td></td>
</tr>
<tr>
<td>Symmetric Read/Writes</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>RAID Protection</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Asynchronous Replication</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Snapshots – Copy on Write</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Mirroring</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Web Based UI/API</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Role Based Access Controls</td>
<td>✔️</td>
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<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Data Reduction Option</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Thin Provisioning</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>NFS, iSCSI, Fibre Channel</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
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<tr>
<td>Enhanced Data Protection</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>VAAI / vCenter Support</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Ethernet, Fibre Channel</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Increase Performance and Capacity</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td><strong>Switched Fabric</strong></td>
<td></td>
<td>7 Nodes &amp; Up</td>
<td>7 Nodes &amp; Up</td>
<td></td>
</tr>
<tr>
<td>Max. Routers</td>
<td>2</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max Nodes</td>
<td>10</td>
<td>30</td>
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</tr>
</tbody>
</table>
Cisco UCS INVICTA Series
A Deeper Dive
Cisco UCS INVICTA Series
Breaking Down The Products

CPU
BOOT DRIVE
MEMORY
FLASH STORAGE

UCS INVICTA OS
DATA PROTECTION BUFFER
CONNECTIVITY
IO CONTROLLER

BLOCK TRANSLATION LAYER
REPLICATION
DATA PROTECTION
MANAGEMENT
PERFORMANCE
Cisco UCS INVICTA Series
Appliance Breakdown

Single Control Plane

SILICON APPLIANCE

MEMORY
BOOT DRIVE
CPU
DATA PROTECTION BUFFER
CONNECTIVITY
UCS INVICTA OS
FLASH STORAGE

BTL
REPLICATION
DATA PROTECTION

BLOCK TRANSLATION LAYER
RAID
Cisco UCS INVICTA Series
Scale Up/Out Breakdown

Distributed Control Plane
The UCS INVICTA Series
RaceRunner OS
UCS INVICTA Series OS
Eliminates Trade-Offs

- Write Protection Buffer
- Block Translation Layer
- RAID Layer
- Flash Media

Data Persistence

Highest Protection

Fastest Performance

Flash Media

RAID Layer

Block Translation Layer

Write Protection Buffer

Data Persistence

Highest Protection

Fastest Performance
UCS INVICTA Series OS
Streamlines the Write process

Receive
• Data blocks of Various size arrive from Hosts from network interconnects

Protect
• Data Blocks are stored in the power loss buffer and passed onto the Block Translation Layer (BTL)

Optimize
• The Block Translation Layer Aggregates and sizes Data Blocks for the RAID Layer and Flash Media
  • Hash tags are created for each block

Commit
• BTL Optimized Data is flushed across the RAID stripe and Flash erase blocks concurrently
UCS INVICTA Series OS Fast & Efficient Writing
Flash Optimization & Data Protection

STEP 1 | Receive Data
INBOUND WRITES
4K  8K  16K

STEP 2 | Protect Data
CONNECTIVITY
RING BUFFER
4K  8K  16K

STEP 3 | Optimize Data
BTL
WRITE BUFFER
22 MB
CREATE A HASH FOR EVERY 4K OF DATA

STEP 4 | Write Data
Write the RAID stripe and the 2MB NAND Pages concurrently

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UCS INVICTA Series OS
Optimization = High Performance

Inbound data blocks
Fill
Write

Cache

Block Translation Layer

Optimize
Write

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NAND Flash Fundamentals:

Flash Write Process

1. NAND Page contents are read to a buffer.
2. NAND Page is erased (aka, “flashed”).
3. Buffer is written back with previous data and any changed or new blocks – including zeroes.
NAND Flash Fundamentals:
Mitigation Methods Used By Competition

Intelligence embedded in flash controller
- Caching
  - Increases data volatility requires pFail protection on per device basis
- Complex GC
  - Non deterministic performance
  - Drives lack resources to make efficient decisions
- Complex driver model (PCIe)
  - Steals CPU/Memory resources from the host reducing scalability

Mirroring instead of parity
- Increased $/GB costs
UCS INVICTA Series OS
Optimization = High Performance

Inbound data blocks
Fill
Write

Cache

Write

Optimize

Block Translation Layer
UCS INVICTA Series OS

NAND Management

Treats NAND Flash like NAND not like disk
- Proprietary write logging layer ensures data integrity in the face of power loss
- Implements a SYSTEM wide log structured indirection layer
  - NEVER writes less than an entire Erase block
  - Smaller writes are padded to the EB boundary
  - Writes are acknowledged to initiator immediately after being recorded into NV memory
  - Leverages multi-core high frequency X86 cores w/ GBs of memory

Data integrity layer provides both positional validation as well as traditional data validation upon read
- Media checksums alone fail to protect positional integrity
- Granular recovery allows for individual RAID stripe repair
Parity based RAID has redundancy calculated at the stripe level.
Drives store chunks:
# of drives * chunksize = stripe size
All chunks must be read to calculate parity information.
Short writes (smaller than chunk) require reading all elements to calculate parity.
Worst case in a 24 drive system is 21 reads to do a SINGLE write operation.
BTL *NEVER* does this:
WBs are multiples of stripe size and EB size.
Allows for less wear AND better $/GB
Cisco UCS INVICTA has integrated data de-duplication

- Configured at order time
- Up to 10:1 overcommit ratio

High performance and IN-LINE

- ~ 200K IOPS READ
- ~ 160K IOPS Write

Integrated into VAAI (XCOPY and WRITE-SAME)

Integrates into INVICTA

Can co-exist with existing “performance nodes”
Only unique data segments are written.

Data is already there, so only additional pointers are stored – not the second instance of the data.

New data segment identified and written.

Blocks of Data Written:

1. First Instance
2. Duplicate Instance
3. Modified Instance
Every incoming write is hashed a 4K boundary
   Hash function is high performance (MM3)
Hash is compared to all existing hashes in MEMORY
   Using the hash as an array index
Upon match
   Media read verifies the duplication
      A miss-match forces a unique store
      A full match stores a pointer

VAAl integration
   XCOPY commands don’t have to transverse the hashing function
      Simple pointer creation and reference count increment
UCS INVICTA Series OS
Balances I/O To Meet Write & Read Demands From Multiple Workloads

Symmetrical vs. Asymmetrical performance

INVICTA (4 Nodes)  Array E (4 Nodes)  Array K (5 nodes)

WRITE/READ Parity

WRITE/READ Disparity

IOPS

0 100,000 200,000 300,000 400,000 500,000 600,000

100% 4K Writes

Parity

Disparity

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UCS INVICTA Series OS
Delivering high performance for multiple applications
UCS INVICTA Series OS
Multi-workload Test Architecture

Workload Engines
- SC 2012 Endpoint Protection
- XenDesktop

Workload Type
- 300 Desktop Anti-Virus Scan
- 600 Desktop Boot Storm

Workload Demand
- 225,000 IOPS .95 GB/s
- 110,000 IOPS 2.3 GB/s
- 335,000 IOPS 3.23 GB/s

Workload Type Demand
- 335,000 IOPS
  - Raid 5 HDD Equivalent = 3,800
  - RAID 10 HDD Equivalent = 2,000

6 Hosts ESX 5.1 with (2) 8G FC Links
2 SSRs with (4) 8G FC links

INVICTA
- 350,000 IOPS
- 3.5 GB/s
- 18 TB
UCS INVICTA Series OS
Multi-workload Test Architecture

Workload Engines

- Dell DVD Store
- VMWare View
- SQLIO

Workload Type

- 1200 Transactions Per Second (Continuous)
- 600 Desktops Boot Storm (2:30)
- Heavy OLTP Simulation 100% 4K Writes (Continuous)
- Batch Report Simulation 100% 64K Reads (Continuous)

Workload Demand

- 4,000 IOPS .05 GB/s
- 109,000 IOPS .153 GB/s
- 86,000 IOPS .350 GB/s
- 16,000 IOPS 1 GB/s

INVICTA
- 350,000 IOPS
- 3.5 GB/s
- 18 TB
- 8 Servers

Raid 5 HDD Equivalent = 3,800
RAID 10 HDD Equivalent = 2,000
UCS INVICTA Series OS
Delivering high performance for multiple applications

Stateless UCS Servers with Virtualized Adapters

Workload Acceleration & Data Reduction Nodes

- 250 Desktops & Infrastructure
- 250 Desktops & Infrastructure
- Databases OLTP
- 500 Desktop Users' Data
- Maintenance

- 250 Desktops
- Databases
- OLTP

- 3TB, 1.9 GB/s
- 24TB, 1.9 GB/s
- 6TB, 1.5 GB/s
- 3TB, 1.9 GB/s

- 250K IOPS
- 250K IOPS
- 48TB Effective 200K IOPS
- 250K IOPS

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Scaling Architectures
## UCS INVICTA Series Architecture

Scale Up Architecture: Single Control Plane

<table>
<thead>
<tr>
<th>Storage Controller</th>
<th>Storage Shelf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host Connectivity</td>
<td>Flash Memory Devices</td>
</tr>
<tr>
<td>CPU, Memory &amp; OS</td>
<td>I/O Connectivity</td>
</tr>
</tbody>
</table>

### Storage Functions
- Volume Management
- RAID
- Replication
- Snapshots
- Cloning
- Thin Provisioning
- De-Duplication
- Compression
UCS INVICTA Series Architecture
Scale out architecture: Duplicated/Distributed Control Plane

<table>
<thead>
<tr>
<th>Storage Nodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host Connectivity</td>
</tr>
<tr>
<td>CPU, Memory &amp; OS</td>
</tr>
<tr>
<td>Flash Memory Devices</td>
</tr>
<tr>
<td>I/O Network Connectivity</td>
</tr>
<tr>
<td>Storage Functions</td>
</tr>
<tr>
<td>Volume Management</td>
</tr>
<tr>
<td>Snapshots</td>
</tr>
<tr>
<td>Cloning</td>
</tr>
<tr>
<td>Thin Provisioning</td>
</tr>
<tr>
<td>De-Duplication</td>
</tr>
<tr>
<td>Compression</td>
</tr>
</tbody>
</table>
## UCS INVICTA Series Architecture

Scale Up/Out Architecture: Separated & Distributed Control Plane

<table>
<thead>
<tr>
<th>Silicon Router</th>
<th>Silicon Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host Connectivity</td>
<td>Flash Memory Devices</td>
</tr>
<tr>
<td>CPU, Memory &amp; RACERUNNER OS</td>
<td>CPU, Memory &amp; RACERUNNER OS</td>
</tr>
<tr>
<td><strong>Switched Fabric</strong></td>
<td><strong>Switched Fabric</strong></td>
</tr>
<tr>
<td><strong>Storage Functions</strong></td>
<td><strong>Storage Functions</strong></td>
</tr>
<tr>
<td>- Host Presentation</td>
<td>- Flash Management</td>
</tr>
<tr>
<td>- Mirroring</td>
<td>- Volume Management</td>
</tr>
<tr>
<td>- Replication</td>
<td>- RAID</td>
</tr>
<tr>
<td>- Snapshots</td>
<td>- De-Duplication</td>
</tr>
<tr>
<td>- Reporting</td>
<td>- Thin Provisioning</td>
</tr>
<tr>
<td>- Node Grouping</td>
<td>- Power-Fail Data Protection</td>
</tr>
<tr>
<td>- Stripping</td>
<td></td>
</tr>
</tbody>
</table>
UCS INVICTA Series Architecture
Networked Routers & Nodes

**SILICON ROUTERS**
- Adding Routers increases throughput to the nodes
- Manages Nodes and storage functions
- Can manage mixed node types

**SILICON NODES**
- Add nodes to Increase overall performance, capacity and capability
- Each Node Independently manages storage functions and Flash Management.
## UCS INVICTA Series Architecture

### Scaling Architecture Comparison

<table>
<thead>
<tr>
<th></th>
<th>Add Capacity</th>
<th>Add Nodes</th>
<th>Add Routers &amp; Nodes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scale Up Array</strong></td>
<td>Centralized</td>
<td>Duplicated/Distributed</td>
<td>Separated/Distributed</td>
</tr>
<tr>
<td><strong>SAN Port Consumption</strong></td>
<td>Controllers (Few)</td>
<td>Nodes (Many)</td>
<td>Routers (Few)</td>
</tr>
<tr>
<td><strong>Operating System</strong></td>
<td>Centralized</td>
<td>Distributed</td>
<td>Distributed</td>
</tr>
<tr>
<td><strong>Performance Scaling</strong></td>
<td>Fixed</td>
<td>N+1</td>
<td>RxN+1</td>
</tr>
<tr>
<td><strong>Device Connectivity</strong></td>
<td>Point-to-Point</td>
<td>Peer Network</td>
<td>Routed Network</td>
</tr>
<tr>
<td><strong>Device Capabilities</strong></td>
<td>Storage Shelves</td>
<td>Uniform Nodes</td>
<td>Flexible Nodes</td>
</tr>
<tr>
<td><strong>Data Placement</strong></td>
<td>Constrained</td>
<td>Distributed</td>
<td>Constrained or Distributed</td>
</tr>
<tr>
<td><strong>Data Protection</strong></td>
<td>RAID</td>
<td>Non-RAID</td>
<td>RAID</td>
</tr>
<tr>
<td><strong>Data Replication</strong></td>
<td>Controller Function</td>
<td>Generally No</td>
<td>Router Function</td>
</tr>
</tbody>
</table>
UCS INVICTA Series Architecture
Comparing Flash Vendor Architectures

PCIe
- EMC
- Fusion-IO
- HDS/ Virident
- LSI
- Violin

Appliance
- Cisco
- Astute
- Nimbus
- IBM
- NetApp
- Skyera
- Violin

Scale Up
- Dell
- HDS
- HP
- Nimbus
- Pure Storage
- EMC VNX-F

Scale Out
- Kaminario
- SolidFire
- EMC XtremIO

Scale Up/Out
- Cisco
Scale Up/Out Architecture
CISCO UCS INVICTA Series
Scale Up / Scale Out Architecture

Silicon Routers

Workload Acceleration and Data Reduction
Silicon Nodes

Switched Fabric

Using Invicta OS 5.0
Cisco UCS INVICTA Series
Scale Up / Scale Out Architecture

Using Invicta OS 5.1
Cisco UCS INVICTA Series
Scale Up & Out Mix & Match Performance and Data Reduction

Silicon Routers

Switched Fabric

Performance Nodes
1,800,000 IOPS
216 TB

Data Reduction Nodes
990,000 IOPS
384TB Effective

OLTP Analytics
Batch Database Loads

Virtual Desktops
Email
Web Logs

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Cisco Public
Cisco UCS INVICTA Series
Scale Up & Out: Balancing Performance & Capacity

- **2 Routers & 30 Nodes**
  - Throughput 14 GB/s
  - IOPs 4,050,000
  - Raw Capacity 720TB

- **3 Routers & 27 Nodes**
  - Throughput 21 GB/s
  - IOPs 3,645,000
  - Capacity 684TB

- **4 Routers & 24 Nodes**
  - Throughput 28 GB/s
  - IOPs 3,240,000
  - Capacity 576TB

- **5 Routers & 21 Nodes**
  - Throughput 35 GB/s
  - IOPs 2,835,000
  - Capacity 504 TB

- **6 Routers & 18 Nodes**
  - Throughput 42 GB/s
  - IOPs 2,430,000
  - Capacity 432TB
Cisco UCS INVICTA Series
Taking Data Centers To A New Level

Old Architecture
- Flash $ trending down
- Data set sizes increasing
- Little benefit from complexity

Stranded Pools
- Inflexible
- Lacks HA, DP
- Island Architecture

Flash Shelves
- Too Many Mgmt Points
  - Lack global namespace
  - Management & Control planes don’t scale
  - Lacks HA, DP

Hybrid / Tiered

PCIe Flash Cards

All-Flash Arrays
- New Media in Old Architecture
  - Removes tiering complexity
  - Not scalable

The new generation of converged infrastructure

UCS+INVICTA
- Scalable, Protected Performance
  - Joint, per-policy provisioning
  - Flexible to address any workload
  - Cost-effective
  - Extensible

Cisco UCS INVICTA Series
Taking Data Centers To A New Level
Cisco UCS INVICTA Series
UCS Director v4.0.1.1

Supported Platforms:
• Scaling Array
• Appliance
• API Version – 1.5

Features: Stack View
• Inventory Features (SSN, SSR)
• CRUD Operations & Reports
  Volume Group, Initiator Groups
  LUN, VLAN, Virtual Interface and Bond
• Converged View
• Solution Flows – SMT (iSCSI, FC*)
• Bare Metal (iSCSI & FC*)
Cisco UCS INVICTA Series
UCS Director v4.0.1.1

Features: Stack View

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Cisco UCS INVICTA Series
Direct Connect to UCS

Fabric Interconnects

Switched Fabrics

Routers

Stateless UCS Servers with Virtualized Adapters

Workload Acceleration & Data Reduction Nodes
Cisco UCS INVICTA Series
SAN Connectivity

Fabric Interconnects
SAN Switch
Switched Fabrics
Routers

Stateless UCS Servers with Virtualized Adapters
Workload Acceleration & Data Reduction Nodes
Cisco UCS INVICTA Series
Managing Compute and Solid-State Resources in the Unified Fabric

- Performance with Data persistence and high availability
- Multi-tenant / Multi-Workload: big data and relational DB on one platform
- (Re)Allocate pooled resources rapidly for real-time decision making

Mixed Density Rack / Blade
Stateless UCS Servers with Virtualized Adapters

UCS Central - UCS Manager - UCS Director
Fabric Interconnects
Switched Fabrics
Routers

Performance Nodes
OLTP Analytics
Batch Data Loads

Data Reduction Nodes
Virtual Desktops
Email

Workload Acceleration & Data Reduction Nodes
Cisco UCS INVICTA Series

Invicta = UCS and WHIPTAIL Integration

WHIPTAIL ported to Cisco UCS C240 M3 for single-node and scale out offerings.

Global Orderability is turned on.

UCS Invicta Go-To-Market will be with UCS only.

Global reach and high touch value of Cisco TAC, AS and supply chain brought to WHIPTAIL products

Shipping for Stand Alone and Scale out is imminent

UCS Director integration

  Inventory Reports and Workflow automation

Future UCS Manager integration with Invicta OS on a variety of hardware form factors
Call to Action…

Visit the World of Solutions:-

- Cisco Campus
- Walk-in Labs
- Technical Solutions Clinics
- Meet the Engineer

- Lunch Time Table Topics, held in the main Catering Hall

- Recommended Reading: For reading material and further resources for this session, please visit www.pearson-books.com/CLMilan2014
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