Compellent & VMware

Why the Virtual Data Centre Starts with Compellent

VMUG 2009

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Agenda

- Who is Compellent?
- Compellent and VMware Relationship
- Compellent Technology Basics
  - Dynamic Block Architecture
  - Virtualization
  - Thin Provisioning
  - Data Instant Replay
  - Data Progression
  - Remote Instant Replay
- Implementation Concepts for VMware Environments
  - DR Protection and Testing
    - VMware Site Recovery Manager
  - Boot from SAN
  - Scripting Integration
    - PowerShell/CompCU
Compellent

Compellent is completely redefining the impact data storage can have on enterprises around the world

- Storage DNA of team
- World’s fastest growing storage company
  - 3 years in a row!
- NYSE:CML
- Award-winning products – SAN of the Year
- Lowest TCO in the industry
- Worldwide installs across all industries
  - 98% customer satisfaction ratings

World-Class Support

“The most knowledgeable support staff belongs to Compellent.” April 2008
> 1,700 Customers
3,000 systems installed
30+ Countries
All major vertical industries
BeNeLux Customers

- Donaldson
- HENDRIX GENETICS
- Welten
- WIT-GELE KRIJS
- ZEEMAN
- Gemeente Amsterdam
- STAPLES
- NETWORK SOLUTIONS
- business lease
- randstad
- zgt
- LCP.be
- Van Ameyde (Zero)70
- VVE 010
- IOB
- NedCar
- Ministerie van Binnenlandse Zaken en Koninkrijksrelaties
- WARTBURG COLLEGE
- BLOG
- Zeeman
- Smart Telecom Management
- Radboud University Nijmegen

Compellent, 5
Compelling Quarterly Revenue Growth

16 consecutive quarters of revenue growth

Quarterly Revenue Growth
Through 9/30/09

($MM)

IPO

Q105 Q205 Q305 Q405 Q106 Q206 Q306 Q406 Q107 Q207 Q307 Q407 Q108 Q208 Q308 Q408 Q109 Q209 Q309

$1.3 $3.0 $2.6 $3.0 $3.3 $6.2 $6.3 $7.5 $8.9 $12.1 $13.4 $16.9 $18.3 $21.0 $24.6 $27.0 $28.1 $28.7 $32.2
Industry Recognition

**Awards**

- Microsoft Gold Certified Partner
- 2008 Advanced Infrastructure Solutions Partner of the Year Winner
- Best Practices in Infrastructure Management Award
- 2008 15 Green Award Winner

**Reviews**

- “powerful, flexible and cost-effective”
- “best management console”
- “sophisticated thin provisioning”
- “fast track to tiered storage”
- “one of the most intuitive interfaces”
- “unique data classification”
- “real magic with virtual snapshots”
- “remarkable value prop”
- “radical thin-replication”
SAN Market Window of Customer Ratings

**Methodology**

**Promise Index:** The strength of a vendor’s marketing “promises” is measured by customer ratings of Competitive Positioning, Technical Innovation, Management’s Strategic Vision, and Brand/Reputation.

**Fulfillment Index:** Vendor fulfillment is measured by customer ratings of Value for the Money, Product Quality, Delivery as Promised, and Technical Support.

The dashed lines represent the mean of the scores received by all vendors rated in the current wave, including those not depicted in the chart.

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Promise Score</th>
<th>Fulfillment Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>72</td>
<td>74</td>
</tr>
<tr>
<td>3PAR</td>
<td>76</td>
<td>81</td>
</tr>
<tr>
<td>Compellent</td>
<td>94</td>
<td>100</td>
</tr>
<tr>
<td>Dell</td>
<td>73</td>
<td>81</td>
</tr>
<tr>
<td>EMC</td>
<td>73</td>
<td>72</td>
</tr>
<tr>
<td>HDS</td>
<td>73</td>
<td>75</td>
</tr>
<tr>
<td>HP</td>
<td>66</td>
<td>67</td>
</tr>
<tr>
<td>IBM</td>
<td>67</td>
<td>88</td>
</tr>
<tr>
<td>NetApp</td>
<td>75</td>
<td>67</td>
</tr>
<tr>
<td>Sun</td>
<td>51</td>
<td>55</td>
</tr>
</tbody>
</table>
Top Tier Technology Partnerships

Strong relationships with industry partners leads to high levels of customer satisfaction

- Joint customer support agreements
- Certified and validated
- Ongoing interoperability testing
- Best practices guidance
- Collaborative design efforts
Compellent VMware Partnership

- Partnership
  - Technology Alliance Partner (TAP) Support

- Support
  - TSANet
    - Compellent Storage Center in Palo Alto Support Lab

- Certifications
  - Hardware Compatibility List (HCL)

- Events
  - VMworld – Gold Sponsor
    - October, 2009
  - VMworld Europe
    - February, 2009
VMware Hardware Compatibility List

- Compellent HCL Certifications

Storage Array Device and Model Information

The detailed lists show actual vendor devices that are either physically tested or are similar to the devices tested by VMware or VMware partners. VMware provides support only for the devices that are listed in this document. Click on the 'Model' for details.

Results Found: 2 Results Displayed: 1-2

<table>
<thead>
<tr>
<th>Partner Name</th>
<th>Model</th>
<th>Array Type</th>
<th>Supported Releases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compellent</td>
<td>Storage Center FC</td>
<td>ESX 4.0, ESX 3.5 U4, ESX 3.5 U3, ESX 3.5 U2, ESX 3.5 U1, ESX 3.5, ESX 3.0.3, ESX 3.0.2 U1, ESX 3.0.2, ESX 3.0.1, ESX 3.0</td>
<td></td>
</tr>
<tr>
<td>Compellent</td>
<td>Storage Center iSCSI</td>
<td>ESX 4.0, ESX 3.5 U4, ESX 3.5 U3, ESX 3.5 U2, ESX 3.5 U1, ESX 3.5, ESX 3.0.3, ESX 3.0.2 U1, ESX 3.0.2, ESX 3.0.1, ESX 3.0</td>
<td></td>
</tr>
</tbody>
</table>
Compellent Advantage: Dynamic Block Architecture™

- **Storage Pool**
  - Collection of disk blocks
  - Maps blocks to volumes
  - Maintains metadata

- **Fast data movement on array**
  - Change RAID levels by re-pointing pages
    - System manages data mapping across multiple RAID levels
    - Individual files can span multiple drive types and RAID levels
  - Re-stripe data when adding drives

- **Storage grows/shrinks as needed**
  - Self defragmentation and tuning

- **Server simply sees a large disk**
Hardware Overview

Server and disk drive technology independence — Mix and match any combination

Storage Center Controllers
- Standards-based hardware
- Server and disk connections via PCI cards
- Controller clustering for high availability — “Shared nothing” approach
- High-speed mirrored, write-back cache

Storage Center Disk Enclosures
- Scale from 1TB to over 700TB
- Expand storage online
- FC switched disk enclosures (SBOD) — Drives supported: SSD, 15K, 10K
- SATA disk enclosures
- SAS disk enclosures – 15K, 7.2K
The Future’s Built In

No more “forklift” upgrades – single scalable platform

- Investment protection
- Simple, low-cost upgrades
- Customer loyalty
- Focused R&D
- Reduced inventory levels
- Low-risk balance sheet

2004 → Today

CX200/400/600  CX300/500/700  CX3-20/40/80  CX4 Family

FAS 200 Series  FAS 900 Series  FAS 3000 Series  FAS 3100 Series
Stop Buying Software Every 3-5 Years

Reduce Software License Costs

Don’t spend twice!

- Perpetual software license
- With Compellent there are no hidden software license costs when you upgrade

Fairer Software Licensing / No Hidden Costs

Software Licensing

Significant software savings with Compellent’s perpetual software licensing model
## Block-level virtualization improves asset utilization and performance

**Virtualization Benefits**

- Optimized data placement
- All volumes span all drives
- Higher performance
- Change RAID levels anytime
- No performance tuning
- Simplified capacity planning

### Compellent Advantage vs. Traditional

<table>
<thead>
<tr>
<th>Feature</th>
<th>Compellent</th>
<th>Traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive type/speed</td>
<td>Multiple</td>
<td>One</td>
</tr>
<tr>
<td>RAID type</td>
<td>Multiple</td>
<td>One</td>
</tr>
<tr>
<td>Drive capacity</td>
<td>Any</td>
<td>One</td>
</tr>
<tr>
<td>Change RAID level</td>
<td>Any time</td>
<td>Downtime required</td>
</tr>
<tr>
<td>Performance tuning</td>
<td>Automatic</td>
<td>Manual</td>
</tr>
<tr>
<td>Auto re-stripping</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

![Diagram showing Compellent's Approach vs. Traditional Disk Mapping](image-url)

Reduced System Complexity

Block-level virtualization improves asset utilization and performance.
Enabling Efficient Storage Utilization

Eliminate the need for provisioning empty space

**Thin Provisioning Benefits**
- Only consume capacity when data is written
- Reduce disk drive, space, power and cooling costs
- Instant volume creation
- Automatic growth with applications
- Performance gains
- Thin Import for immediate savings

**Dynamic Capacity Advantage**

**Traditional Thin Provisioning**
- Much larger chunks
- Pre-allocation required
- Snapshots not thin provisioned

**Compellent**
- Windows—unrecoverable space
- “Fat” data migrations
- Limitations on application usage
Dynamic Capacity

- Dynamic Capacity works with VMware ESX just as it would with any other operating system.
- Although VMware allocates the storage for each virtual disk (vmdk) it creates, it does not actually write data to that virtual disk until it needs to, thus leaving white space within the volume.

![100 GB Compellent Volume Diagram](image)
The Only Storage System that Works For You!

The ONLY SAN to automate ILM inside the volume

Benefits

- Patented technology automatically moves inactive data to lower RAID and disk tiers
- Eliminates RAID 5 write penalty
- 74% less disk costs
- Reduced power, cooling and floor space
- Automatically move snapshots to lower tiers
- No server side agents required

Data Progression Advantage

Traditional Approach to Tiered Storage

- Entire Volume movement only
- Manual data classification
- Extra software on each server
Data Progression

- Data Progression works with VMware just as it would with any other operating system, sorting blocks of data by frequency of access.
Rapid Data Recovery

Industry’s most advanced snapshots reduce downtime and save time

### Data Instant Replay Benefits

- Readable and writeable *instantly*
- Space efficient – freeze pointers
- No space pre-allocation
- Integration with common applications
- Reduce dependence on tape
- Patented technology

### Data Instant Replay Advantage

<table>
<thead>
<tr>
<th></th>
<th>Replays</th>
<th>Traditional Snapshots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mount by any server</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Recovery time</td>
<td>Seconds</td>
<td>Hours–Cloning required</td>
</tr>
<tr>
<td>Writeable</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Boot volume</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Maximum allowed</td>
<td>Unlimited</td>
<td>Limited 8-12</td>
</tr>
<tr>
<td>Pre-allocation</td>
<td>None</td>
<td>20-50% required</td>
</tr>
<tr>
<td>Copy-on-write</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Drive type used</td>
<td>Any–user defines</td>
<td>Same as active volume</td>
</tr>
</tbody>
</table>

Compellent Approach:

- 8:00
- 8:15
- 8:30
- 8:45

Readable and writeable instantly, Space efficient – freeze pointers, No space pre-allocation, Integration with common applications, Reduce dependence on tape, Patented technology.
### Benefits

- **Diskless servers & Desktops**
- **Avoid unnecessary Duplication of Data in the first place**
- **Thin provisioned boot volumes & VDI images**
- **Easy to replicate boot & VDI images for DR**
- **Less power, cooling and floor-space for Virtual Servers & VDI**

### Virtual Snapshot Clones – Avoid Boot & VDI Duplication

<table>
<thead>
<tr>
<th>Virtual Server Boot Vols</th>
<th>VDI Desktop Vols</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COMPELLENT STORAGE</strong></td>
<td></td>
</tr>
<tr>
<td><strong>SERVER BOOT IMAGES</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Available Storage</strong></td>
<td></td>
</tr>
</tbody>
</table>

![Diagram of diskless servers and virtual desktops with virtual snapshot clones](image-url)
Simplified, Low-cost Disaster Recovery

Live testing anytime, fast recovery minimizes outage time

**Thin Replication Benefits**
- Anytime DR validation
- Significant reduction in bandwidth and management costs
- No space pre-allocation
- Integrated IP & FC – No extra hardware to buy
- Replication in 6 clicks
- One button, automated restore
- Patented technology

**Remote Instant Replay Advantage**

<table>
<thead>
<tr>
<th>Quality of Service</th>
<th>M-F 8:00 – 17:00</th>
<th>M-F 17:00 – 5:00</th>
<th>Sat 0:00 – 24:00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oracle</td>
<td>45%</td>
<td>10%</td>
<td>30%</td>
</tr>
<tr>
<td>Exchange</td>
<td>45%</td>
<td>10%</td>
<td>30%</td>
</tr>
<tr>
<td>File servers</td>
<td>10%</td>
<td>80%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Oracle: 45% M-F 8:00 – 17:00, 10% M-F 17:00 – 5:00, 30% Sat 0:00 – 24:00
Exchange: 45% M-F 8:00 – 17:00, 10% M-F 17:00 – 5:00, 30% Sat 0:00 – 24:00
File servers: 10% M-F 8:00 – 17:00, 80% M-F 17:00 – 5:00, 40% Sat 0:00 – 24:00

Orlando London New York

Thin Provisioned Volume Replay Schedule
VMware Replication

- Virtual machine volumes can be replicated to a disaster recovery site easily over iSCSI or Fibre Channel.

- Compellent has a Storage Replication Adapter (SRA) to integrate with VMware Site Recovery Manager to quickly recover virtual machines at the DR site.
Introduction to Site Recovery Manager

- VMware Site Recovery Manager is a tool used for automating your virtual infrastructure disaster recovery
  - Eliminate complex manual recovery steps
    - Presenting datastore volumes to the server
    - Adding virtual machines to inventory
    - Changing IP address’ of virtual machines
    - Powering on virtual machines in a specific order
    - Can execute custom scripts for miscellaneous DR tasks
  - Non-disruptively test disaster recovery plans
    - Without disruption to active replications
    - Automatic creation of an isolated test network
    - Automated cleanup after each test run
  - Initiate a recovery with a single button
    - “CEO Recovery” – With proper credentials, the recovery is easy enough for any employee to execute
The Storage Replication Adapter (SRA) created by Compellent, allows SRM to communicate with Compellent Enterprise Manager to execute a basic set of disaster recovery tasks
- Discover Arrays
- Discover LUNs
- Test Failover
- Start Failover
- Stop Failover

Reversing the failover in SRM
- Failing the virtual infrastructure back to the main site can be automated by reversing the replications and configuring SRM to fail in the opposite direction.
- Failback instructions are included in our Enterprise Manager documentation
Why Choose Compellent for SRM?

- Many vendors have SRM capabilities, none as easy to setup and configure as Compellent
- 6 – Click replication with Compellent Enterprise Manager
- Large number of our customers currently replicate between at least two sites
- Can have different SAN configurations between Main and Recovery sites
- Built in Replication which eliminates the need for additional hardware
- Thin Replication which eliminates the need for high speed connections between sites
Enterprise Manager Benefits

- Chargeback costs based on actual storage consumption
- Easily showcase storage cost and power savings
- Recover Windows space
- Cut administrative time
- Lower network bandwidth costs, reduce disk expenditures

Compellent Advantage

- Robust reporting capabilities
- Single pane of glass for multiple systems
- Bandwidth shaping and simulation
- Six clicks to replication

Enterprise Manager
Unified Storage

One Platform for all Block and File IO Requests

Unified Storage Benefits

- Combine block and file storage into a single pool
- Integrated Management with VDS
- SIS Combined with Free Space Recovery!
- Distributed File System
- Powerful Search/indexing
- 8-way Cluster, MPIO
- Single Support Contact

Compellent Advantage

- Windows Storage Server 2K8
- 8 GB Cache
- 64 Bit Architecture
- 3 GHz Dual Core
- FC or iSCSI Connectivity
- 4 x Gb Ethernet Ports
A New Way to Enhance Automation…

Automate Data Center Tasks with PowerShell

MS PowerShell Automation

- Fully integrated with MS PowerShell:
- Dramatically reduces time for storage administration tasks
- Automate Microsoft Exchange Storage Management
  - Create new volumes for Microsoft Exchange (see sample script)
- Simplify Virtual Machine Creation and Configuration
- Automatically Map Storage to HA Clusters
- Standardize Complex Test & Dev Environments

<table>
<thead>
<tr>
<th>Task</th>
<th>Using PowerShell</th>
<th>Manual Setup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create 50 new user accounts for everyone in a Microsoft Active Directory user group</td>
<td>Seconds</td>
<td>Hours</td>
</tr>
<tr>
<td>Create and map hundreds of volumes in an eight-node Microsoft cluster</td>
<td>Minutes</td>
<td>Days</td>
</tr>
<tr>
<td>Provision storage for hundreds of virtual servers</td>
<td>Minutes</td>
<td>Days</td>
</tr>
</tbody>
</table>

```powershell
# Get last replay from volume
Get-SCReplay -SourceVolumename $volumename | Where-Object { $_.State -eq "Frozen" }

If ($replays -eq null -or $replays.Count -eq 0)

foreach ($replay in $replays)

# Create new volume
Get-SCVolume -SourceReplay $replay -Name $newvolume

# Map view to server
Get-SCVolumeMap -volumeIndex $replayview.Index -ServerIndex $server.Index -SinglePath

# Rescan Server
Rescan-DiskDevice -Server $servername -RescanDelay $delay
```

Compellent, 30
Raw Device Mappings

- Used for mapping a volume directly to a virtual machine
  - An RDM mapping file (similar to a symbolic link), is created to “point” the virtual machine to the raw LUN

- Why and when to use an RDM?
  - Clustering
    - Virtual to Virtual clustering
    - Virtual to Physical clustering
  - Utilize SAN functionality
    - For example: **Free Space Recovery**
  - Virtual machine writes directly to the volume
    - Allows volume to be mapped to a physical server
  - Can be used to convert physical machines to virtual machines
  - General rule of thumb:
    - Use an RDM for any volume containing transactional databases such as SQL or Exchange, as well as their associated transaction logs
“Compellent Best Practices with VMware ESX”
- Available to everyone through the Compellent Customer Portal
  - This document is best suited for a technical audience that is already familiar with ESX and the Compellent Storage Center
  - Answers a lot of questions that customers may have about how to configure ESX to work best with their Compellent system
  - Has been reviewed by VMware

VMware Technology Network (VMTN)
- Knowledge base, technical papers, documentation, and discussion forums
  - Great for finding VMware answers

VMware also has documents on their web site such as:
- “Performance Tuning Best Practices for ESX”
- “SAN System Design and Deployment Guide”
- “Fiber Channel SAN Configuration Guide”
Delivering Efficient Storage Through Innovative Software

Multiple advanced features that save customers money
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