Extending Object Storage to Tape

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Spectra Logic overview

• Over 30 years of innovative technology
  – Founded in 1979, Fully self-funded
  – Debt-free growth, Profitable, Year over year
  – Well established >22,000 installations
  – Culture of Innovation, Average R&D expenditure 11% of top line revenue
    • Last year and this year at >16%
• All manufacturing in Boulder, Colorado, USA (excluding T50e)
LTO-7 Update
A Long and Trusted Roadmap: (LTO) Ultrium

The industry standard for tape technology

<table>
<thead>
<tr>
<th></th>
<th>LTO-3</th>
<th>LTO-4</th>
<th>LTO-5</th>
<th>LTO-6</th>
<th>LTO-7</th>
<th>LTO-8</th>
<th>LTO-9</th>
<th>LTO-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipment Year</td>
<td>2006</td>
<td>2007</td>
<td>2010</td>
<td>2013</td>
<td>2015</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Native Capacity</td>
<td>400GB</td>
<td>800GB</td>
<td>1.5TB</td>
<td>2.5TB</td>
<td>Up to 6.4TB</td>
<td>Up to 12.8TB</td>
<td>Up to 25TB</td>
<td>Up to 50TB</td>
</tr>
<tr>
<td>Compressed Capacity</td>
<td>800GB</td>
<td>1.6TB</td>
<td>3.0TB</td>
<td>6.25TB</td>
<td>Up to 16TB</td>
<td>Up to 32TB</td>
<td>Up to 62.5TB</td>
<td>Up to 125TB</td>
</tr>
<tr>
<td>Native Transfer Rate</td>
<td>80 MB/s</td>
<td>120 MB/s</td>
<td>140 MB/s</td>
<td>160 MB/s</td>
<td>Up to 315 MB/s</td>
<td>Up to 472 MB/s</td>
<td>Up to 708 MB/s</td>
<td>Up to 1100 MB/s</td>
</tr>
<tr>
<td>Compressed Transfer Rate</td>
<td>160 MB/s</td>
<td>240 MB/s</td>
<td>280 MB/s</td>
<td>400 MB/s</td>
<td>Up to 788 MB/s</td>
<td>Up to 1180 MB/s</td>
<td>Up to 1770 MB/s</td>
<td>Up to 2750 MB/s</td>
</tr>
</tbody>
</table>

Spectra Logic Estimated LTO Roadmap based upon best available market information.

- Target Availability Calendar Q4 2015
# LTO-7 Highlights

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native Capacity</td>
<td>6 to 6.4 TB</td>
</tr>
<tr>
<td>Compressed Capacity</td>
<td>15 to 16 TB</td>
</tr>
<tr>
<td>Native Transfer Rate</td>
<td>300 to 315 MB/sec</td>
</tr>
<tr>
<td>Compressed Transfer Rate</td>
<td>750 to 788 MB/sec</td>
</tr>
<tr>
<td>Read/Write Compatibility</td>
<td>Read/Write Compatible with LTO-6, Read compatible with LTO-5</td>
</tr>
<tr>
<td>Channel Interfaces</td>
<td>Fibre Channel 8 Gb/sec, SAS 6 Gb/sec</td>
</tr>
<tr>
<td>Media</td>
<td>BaFe Formulation</td>
</tr>
<tr>
<td>Tape Head</td>
<td>32 channels</td>
</tr>
</tbody>
</table>
# LTO-7 Specifications Relative to Previous Generations

<table>
<thead>
<tr>
<th>Generation</th>
<th>LTO-1</th>
<th>LTO-2</th>
<th>LTO-3</th>
<th>LTO-4</th>
<th>LTO-5</th>
<th>LTO-6</th>
<th>LTO-7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Data rate (native)</td>
<td>15 MB/s</td>
<td>35 MB/s</td>
<td>80 MB/s</td>
<td>120 MB/s</td>
<td>140 MB/s</td>
<td>160 MB/s</td>
<td>300-315 MB/s</td>
</tr>
<tr>
<td>Capacity</td>
<td>100 GB</td>
<td>200 GB</td>
<td>400 GB</td>
<td>800 GB</td>
<td>1.5TB</td>
<td>2.5 TB</td>
<td>6 to 6.4 TB</td>
</tr>
</tbody>
</table>
What Do the Numbers Mean - Backup

Backup 100 terabytes of data within 8 hour window:

**LTO-5**

13 tape drives and 34 cartridges needed

**LTO-7**

Only 5 drives and 7 cartridges needed

**OR**, with the same number of drives the 8 hour window could be cut to under 2 hours 51 minutes!

*Note:* This is based on compressed performance of 750 MB/sec and compressed capacity of 15 TB. Compression on LTO-5 is 2:1. The ratio for LTO-7 is estimated at 2.5:1.
What Do the Numbers Mean - Backup

Backup 100 terabytes of data within 8 hour window:

**LTO-6**

- - - - - - - - - - - - - - - - - - - - - - - - - - -

- - - - - - - - -

9 tape drives and 16 cartridges needed

**LTO-7**

- - - - - - - -

- - - - - - - -

Only 5 drives and 7 cartridges needed

OR, with the same number of drives the 8 hour window could be cut to under 2 hours 51 minutes!

*Note: This is based on compressed performance of 750 MB/sec and compressed capacity of 15 TB capacity.*
Significant Performance Enhancement

- 32 channel TS technology head actuator
  - Much higher data rates
  - Time reduction of ~ 50% to write/read a cartridge
  - Reduced head wear
## TS1150 Technology vs Competing Drive Types

<table>
<thead>
<tr>
<th>Feature</th>
<th>TS1150 Technology</th>
<th>Oracle T10000 D</th>
<th>LTO-7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity (Native)</td>
<td>10.0 TB</td>
<td>8.0 TB</td>
<td>6 - 6.4 TB</td>
</tr>
<tr>
<td>Transfer Rate (Native)</td>
<td>360 MB/s</td>
<td>252 MB/s</td>
<td>300 - 315 MB/s</td>
</tr>
<tr>
<td>R/W Compatibility</td>
<td>R/W TS1140</td>
<td>R/W T10000 C</td>
<td>R/W LTO-6</td>
</tr>
<tr>
<td></td>
<td>Reformatted TS1140</td>
<td>R only T10000 A, B</td>
<td>R only LTO-5</td>
</tr>
<tr>
<td>Interfaces</td>
<td>8 Gb FC</td>
<td>16 Gb FC</td>
<td>8 Gb FC</td>
</tr>
<tr>
<td></td>
<td>FICON*</td>
<td>FICON</td>
<td>SAS 6 Gb/sec</td>
</tr>
<tr>
<td>Library Compatibility</td>
<td>IBM TS3500</td>
<td>SL8500</td>
<td>Spectra</td>
</tr>
<tr>
<td></td>
<td>IBM TS4500</td>
<td>SL3000</td>
<td>IBM</td>
</tr>
<tr>
<td></td>
<td>Spectra T-Finity*</td>
<td></td>
<td>Oracle</td>
</tr>
<tr>
<td></td>
<td>Spectra T950*</td>
<td></td>
<td>Quantum Libraries</td>
</tr>
<tr>
<td></td>
<td>Spectra T380*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Media Sources</td>
<td>Two</td>
<td>One</td>
<td>Multiple</td>
</tr>
<tr>
<td>Load / Unload Cycles</td>
<td>300,000</td>
<td>&gt;150,000</td>
<td>100,000</td>
</tr>
</tbody>
</table>

* FICON not supported by Spectra.
**LTO-7 Media – Barium Ferrite**

- Metal Particle – Generations 1 through 6 is “out of gas”
- BaFe provides greater linear density because:
  - smaller particle size
  - higher Signal-to-Noise ratio
- Less prone to environmental factors
Future Media Technology

- Fujifilm/IBM developing Barium Ferrite (BaFe) tape particle technology to achieve $85.9\text{Gbit/in}^2 = 150\text{TB+}$ cartridge
- The Sony technology potential to $148\text{Gbit/in}^2$ tape density.
Tape Leverages Disk Technology

Head Technology Example

- GMR disk drives were released in 1993
- LTO went to GMR in 2008
  * LTO-7 just moved to TMR
- Disk now on CMR heads
  (previously TRM & GMR)
No slowing down on the horizon....
How Does Tape Fits in the M&E Environment

Ingest
- Video Tape
- Feeds
- File Based

Broadcast Devices
- Digital Newsroom
- Post Production
- Ingest/Playback Servers

User Applications
- Traffic
- Automation
- Media Asset Management
- News Production

Content Reuse
- IPTV
- VOD
- Web
- Mobile Device
- iPod
- DVD

Content Conversion/Migration
- Video Tape Archives
- Multi-Format VTRs
- Multi-Format Encoders

Content Storage Management
- Advanced Management Servers
- Content Tracking Databases
- Content Movement, Transcoding, and Analysis Engines
- Add Engine and Services as Workflow Evolves

Spectra Logic File-Based Storage Infrastructure
- Disk-Based Archives/Cache
- Data Robotic System
- Archive Tape Media
- Media Library Storage

Nearline → Archive → Offline/DR

DEEP STORAGE EXPERTS
Proven & Established model......

............... But Not Without its Challenges

- Complex
  - Difficult to deploy
- Proprietary in nature
- High Cost
- Difficult to support
  - Multi-vendor
  - Partner dependent upgrades
- Not Future Proof
  - Application level dependency
  - Migration issues
  - Future medium adoption
  - Long term content integrity
We Now Think About Deep Storage
Storage Interface Progression

SCSI

Block

NFS/CIFS

File

Public/Private Cloud

Object
Exploring Object Storage

What is Object Storage

- An emerging alternative to file based systems; ideal for storing large volumes of unstructured data.
- Decouples data from its physical medium or location
- Employs the inclusion of Meta Data, and Universal ID
- Its flat & infinite namespace make possible for large scale storage
- Provides a foundation for data longevity techniques

How do you talk to Object Storage

- RESTful API
- Client server model
- Gateways/Appliances
Domains of Object Storage

• Up to this point in time, Object Storage has been solely the domain of disk technology

• Unaddressed issues are those of *Long Term Retention*
  - Cost
  - Protection
  - Availability - Application level agnosticism
  - Migration
  - Long term data Integrity
  - Mobility
  - Transparent utilization of future media support
How easy is it integrate with Object Storage

- Restful APIs are very easy to use, allowing current & new applications to take advantage of Object Storage
- Some 500,000 applications have been written for S3/RESTful APIs
- Simple web/http methods vs. years of development for block storage programming
- Storage intensive applications can prototype in a few weeks and deploy in months
Tape Made Easy
Leveraging Object Storage & Cloud Technologies
Why is cloud interface the right interface for Deep Storage and Tape?

- Easy to deploy within existing web infrastructure
- Storage Agnostic (i.e. not tied to any particular storage medium)
- Easy to scale
- Object based with meta-data
- Makes tape storage directly available to the application
- Young developers just get it! (S3, DropBox, Google Drive, etc.)
DS3 RESTful API....

RESTful API (S3) + Sequential Media Support + Removable Media Support = Deep Simple Storage Service

Optimized for Bulk Object Movement & Storage

Black Pearl

SPECTRA DEEP STORAGE EXPERTS
How Does Deep Storage Work?

Applications w/DS3 Client
MAM/PAM/EDIT
Workflow MGR
(Create/Capture/Edit)

Deep Storage Repository

10 GigE

On Premises or Remote

DS3 API

Objects Created

Inside DS3 Server:
✓ Full abstraction of storage
✓ Managing all aspects
✓ SSDs for object cataloging
✓ HDDs for Cache/buffer
Formats, Migration, Data Life Cycle Management

- All media is written in LTFS Open Format
- Tape media migration is seamless*
- Future data migration to new technologies is equally seamless*
- Data Integrity Verification & Media Life Cycle Management
- Dynamic resource allocation
Cost Containment

- Spectra BlackPearl plus T380 with LTO drives
  - 1.9 PB @ $0.14/GB

- Spectra BlackPearl plus T950 with LTO drives
  - 2.4 PB @ $0.10/GB

- Spectra BlackPearl plus T950 with TS1140 drives
  - 6.4 PB @ $0.09/GB
In its simplest of terms...
Tape Based Object Storage gives you a...

Self managing storage holding
Self describing objects with
Original format files
On an Open standard file system
Residing on a portable media
Without dependencies on any application
 Guaranteeing availability for
When you need it
The Future
WEB based models, RESTful APIs
Buckets, objects, files, Web Model
Open Data Formats
Simple, intelligent

Thank you!

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