Defining The Software-Defined Technology Market

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Forward Looking Statement

This presentation contains forward-looking statements that involve risks and uncertainties, including, but not limited to, the development and adoption of a new storage architecture and the potential introduction of products based on this architecture. Forward-looking statements should not be read as a guarantee of future performance or results, and will not necessarily be accurate indications of the times at, or by, which such performance or results will be achieved, if at all. Forward-looking statements are subject to risks and uncertainties that could cause actual performance or results to differ materially from those expressed in or suggested by the forward-looking statements.

Additional key risks and uncertainties include the impact of continued uncertainty and volatility in global economic conditions; actions by competitors, business conditions and growth in the various hard drive segments. More information about the other risks and uncertainties that could affect our business are listed in our filings with the Securities and Exchange Commission (the “SEC”) and available on the SEC’s website at www.sec.gov, including our Quarterly Report on Form 10-Q filed with the SEC on May 5, 2014, to which your attention is directed. We do not undertake any obligation to publicly update or revise any forward-looking statement, whether as a result of new information, future developments or otherwise, except as otherwise required by law.
Software-Defined Technology

- The new software defined disk drive solution from HGST
- This will be the first time enterprises can run distributed storage/applications directly onto storage media for next generation big data, analytics and research
- How CPU and memory resources residing on these storage devices can be leveraged to run storage services as close to the data as possible
HGST HERITAGE innovations and firsts

1956: First HDD RAMAC

1962: Hydrodynamic Air Bearing Sliders

1973: Winchester Disk IBM 3340 – father of the modern HDD

1978: First disk array subsystem patent

1979: Thin Film Heads

1980: First 5-platter 3.5” design

1990: PRML Channel

1991: MR Heads

1994: First 5TB enterprise HDD with 1M hr MTBF

1997: GMR Heads

1999: 1” Microdrive

2000: National Medal of Technology

2001: AFC Media

2007: First 1TB HDD

2008: First JDA with Intel, Intel SATA SSD JV

2010: Industry’s leading enterprise class SAS SSD

2011: First 7200 RPM enterprise HDD with 2.5" 5-platter 3.5" design

2012: First 6TB helium HDDs shipped

2013: 10-nanometer Bit Pattern media demonstration
40% DATA GROWTH

25 Billion Connected Devices by 2015

+5% productivity, +6% profitability

Source: IDC
Source: Harvard Business Review
Source: Cisco Systems, Inc.
INCREASING amounts of valuable data

2013: 22%  
2020: 37%
“Active” as #1 requirement in storage

- The value of mining data
  - When data is more readily accessible, it’s value increases
- Typically an analytics or compliance use case
  - Access time is ~1s
- Affordable disk media solutions offer ideal price/performance
  - Software-defined storage
DATA CENTER CHALLENGES: Scalability, cost, and accessibility

Built for capacity and cost, not accessibility

Traditional solution

Deep archive solution
REVOLUTIONARY
cost model
INNOVATION leverages device affinity

- Optimized HDDs
- Tuned enclosure
- Device affinity innovations
- Scale out software
OPEN ETHERNET DRIVE ARCHITECTURE

A FOUNDATIONAL BUILDING BLOCK FOR THE SOFTWARE DEFINED DATA CENTER
VENDOR-SPECIFIC ARCHITECTURES

CONFINE THE SCALE-OUT OF GROWING UNSTRUCTURED DATA
A Drive Running Linux…
Leverages the Linux ecosystem

A Drive with CPU & RAM…
Runs storage services directly on the device

A Drive with Ethernet…
Connects storage directly into the data center fabric
“Under the Hood” of the Demo Drive

- Standard 3.5” HDD form factor
- Powerful, low-cost integrated SOC
- Ethernet connectivity
- Demonstrating 4TB, but technology can be applied to any HDD, SSD, etc.
Integrated Demo: Enclosure Example

Reference Design
4U Enclosure
60 drive slots
Embedded switched fabric
Hot-swap components
Provides seamless integration into existing datacenter architectures
10Gbps Ethernet ports
Devices appear as Linux servers
What do I see as a developer?

- Linux - Debian 7.4+ (Wheezy) on demo system
  - Working on next version of Debian (Jessie) in our labs
- CPU - 32-bit ARM, 512KB Level 2 Cache
- Memory - 2GB DRAM, DDR-3
  - 1792 MB Available to Linux
- Block storage driver
  - Drive enumerates as a SCSI disk (/dev/sda)
- Ethernet network driver
  - Enumerates as eth0 device
Photo Evidence
Solutions running as demonstrations

- ceph
- redhat
- Gluster
- openstack
Open Management Framework

My Swift Environments

**Swift_Small**
- Nodes: 4
- CPU (cores): 7
- RAM (GB): 9
- HDD (TB): 8.1
- Operational

**Swift_Large**
- Nodes: 10
- CPU (cores): 13
- RAM (GB): 20
- HDD (TB): 24.4
- Operational

**Swift_X**
- Nodes: 8
- CPU (cores): 9
- RAM (GB): 14
- HDD (TB): 24.2
- Operational

My Ceph Environments

**CEPH_Demo**
- Nodes: 4
- CPU (cores): 7
- RAM (GB): 9
- HDD (TB): 12.0
- Operational

My GlusterFS Environments

**GlusterDemo**
- Nodes: 5
- CPU (cores): 8
- RAM (GB): 11
- HDD (TB): 16.0
- Operational
Intermixing Intel & HGST nodes

```
root@clientmachine:~# ssh 10.20.0.166
Last login: Wed May 14 15:39:56 2014 from 10.20.0.10
[root@intel-17-525400880101 ~]# swift-get-nodes /etc/swift/object.ring.gz AUTH_admin 3_30con smallfile

Account         AUTH_admin
Container        3_30con
Object           smallfile

Partition        7540
Hash             eba03c550dfb936e9d68653dff116ece

Server:Port Device 10.2.0.4:6000 sda4
Server:Port Device 10.2.0.3:6000 sda4
Server:Port Device 10.2.0.5:6000 sdb

curl -I -XHEAD "http://10.2.0.4:6000/sda4/7540/AUTH_admin/3_30con/smallfile"
curl -I -XHEAD "http://10.2.0.3:6000/sda4/7540/AUTH_admin/3_30con/smallfile"
curl -I -XHEAD "http://10.2.0.5:6000/sdb/7540/AUTH_admin/3_30con/smallfile"

ssh 10.2.0.4 "ls -lah /srv/node/sda4/objects/7540/ece/eba03c550dfb936e9d68653dff116ece/"
ssh 10.2.0.3 "ls -lah /srv/node/sda4/objects/7540/ece/eba03c550dfb936e9d68653dff116ece/"
ssh 10.2.0.5 "ls -lah /srv/node/sdb/objects/7540/ece/eba03c550dfb936e9d68653dff116ece/"
```

[...]

[Root@intel-17-525400880101 ~]# ssh 10.2.0.3
Last login: Wed May 14 15:39:56 2014 from 10.2.0.3
OpenStack Swift services running on HGST node

```
[root@intel-17-525400880101 ~]# ssh 10.2.0.3
Last login: Wed May 14 14:56:43 2014 from 10.2.0.2
0 ethdrive-63-060cca00424f:~# ps -ef | grep swift
swift  590  1  8 12:16 ?  00:00:15 /usr/bin/python /usr/bin/swift-account-replicator /etc/swift/account-server.conf
swift  591  1  8 12:16 ?  00:00:09 /usr/bin/python /usr/bin/swift-container-updater /etc/swift/container-server.conf
swift  592  1  8 12:16 ?  00:00:32 /usr/bin/python /usr/bin/swift-object-replicator /etc/swift/object-server.conf
swift  593  1  8 12:16 ?  00:00:08 /usr/bin/python /usr/bin/swift-container-server /etc/swift/container-server.conf
swift  594  1  8 12:16 ?  00:00:06 /usr/bin/python /usr/bin/swift-object-updater /etc/swift/object-server.conf
swift  595  1  8 12:16 ?  00:00:04 /usr/bin/python /usr/bin/swift-container-auditor /etc/swift/container-server.conf
swift  597  1  8 12:16 ?  00:00:08 /usr/bin/python /usr/bin/swift-object-server /etc/swift/object-server.conf
swift  598  1  8 12:16 ?  00:00:08 /usr/bin/python /usr/bin/swift-account-server /etc/swift/account-server.conf
swift  599  1  8 12:16 ?  00:00:08 /usr/bin/python /usr/bin/swift-account-auditor /etc/swift/account-server.conf
swift  600  1  4 12:16 ?  00:00:09 /usr/bin/python /usr/bin/swift-container-replicator /etc/swift/container-server.conf
swift  601  1  8 12:16 ?  00:00:01 /usr/bin/python /usr/bin/swift-object-auditor /etc/swift/object-server.conf
swift  777 601  8 12:16 ?  00:01:48 /usr/bin/python /usr/bin/swift-object-auditor /etc/swift/object-server.conf
swift  851 598  8 12:16 ?  00:00:07 /usr/bin/python /usr/bin/swift-account-server /etc/swift/account-server.conf
swift  857 593  2 12:16 ?  00:06:01 /usr/bin/python /usr/bin/swift-container-server /etc/swift/container-server.conf
swift  859 597  6 12:16 ?  00:15:18 /usr/bin/python /usr/bin/swift-object-server /etc/swift/object-server.conf
swift 16905 591  8 16:03 ?  00:00:08 /usr/bin/python /usr/bin/swift-container-updater /etc/swift/container-server.conf
root 16908 16797  8 16:03 pts/0  00:00:08 grep swift
0 ethdrive-63-060cca00424f:~# ```
Ceph OSD running on HGST node

<table>
<thead>
<tr>
<th>Filters</th>
<th>Unassigned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>There are no nodes of this type</td>
</tr>
</tbody>
</table>

### Ceph Storage

<table>
<thead>
<tr>
<th>Role</th>
<th>Enclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>eth0:73-40 FC</td>
<td></td>
</tr>
</tbody>
</table>

### Ceph Monitor

There are no nodes of this type

### Ceph Storage & Monitor

<table>
<thead>
<tr>
<th>Role</th>
<th>Enclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>eth0:62-40 FC</td>
<td></td>
</tr>
<tr>
<td>eth0:75-42 FC</td>
<td></td>
</tr>
</tbody>
</table>

### Ceph RadosGW & Monitor

<table>
<thead>
<tr>
<th>Role</th>
<th>Everything else</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>eth0:18-01:00</td>
</tr>
<tr>
<td></td>
<td>eth0:18-01:00</td>
</tr>
</tbody>
</table>
Bricks services running on HGST node

GlusterFS DNS

Rack: 0

Everything else

- InetFS-02:00
- 4 / 8.8GB / <4GB

GlusterFS Storage

Rack: 0

Enclosure: 0

- sfdisk-22-40:0B
- 1 / 4.0TB / 3GB
- sfdisk-58-40:0B
- 1 / 4.0TB / 2GB
- localhost-43:01
- 1 / 4.0TB / 2GB
- sfdisk-58:1F:2C
- 1 / 4.0TB / 2GB
Want to Develop with HGST?

Contact me to learn more!

HGST Goal = Work with of cloud software to (re)define the data center of the future

Or, learn how to become a developer at

http://www.hgst.com/opendev
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Thank You

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