CMG Canada Conference

3rd Platform Infrastructures and Software Defined Storage

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While many large enterprises are well on their way in the transformation and adoption of 3rd platform Infrastructures, there are a significant number of those who have not yet started or severely lag behind. According to IDC and a few other industry pundits, 3rd platform drivers can be grouped as a trending, but challenging foursome encompassing: Cloud Services, Mobile Devices, Social Technology, and Big Data (analytics). The Internet of Things may also be considered as a possible fifth trend.

Application design for 3rd platform must incorporate components that can be stateless and scale horizontally; this necessitates a decoupling of the application and data layer processes. Current infrastructures are struggling to adapt to these trends and therefore necessitates the whole scale adoption of computing, networking, and storage paradigms that embraces service oriented architectures; for this reason, cloud computing datacenters have essentially become the main engines of the 3rd platform.

This session discusses the above concepts in order to fully examine the applicability of Software Defined Storage as a major enabler of 3rd Platform Infrastructures. By design, these infrastructures will provide web-scalability, agility, manageability, and performance while optimizing CapEx and OpEx; appropriate examples of currently available cloud storage models will be also be discussed.
Anthony Mungal is a highly motivated IT professional with over thirty five years of expertise in Large Systems/Enterprise Infrastructure and Architecture areas such as computing, storage, networking, systems management, performance and capacity planning. He has worked with a very large and diverse set of customers spanning financial, retail, utilities, health care, government, entertainment and other sectors, both domestically and internationally.

His core competencies include:

• Enterprise Infrastructures and Architectures.
• Storage Operations/Migrations/Cloud.
• Data Center Setup/Migration/Relocation/Cloud deployments.
• System Performance & Tuning (processor, storage, network).
• Capacity Planning & Modeling.
• Excellent written and oral skills.
Agenda

- IT platform progression – cause & effects
- IT Evolution and new trends
- Infrastructures for 3rd Platform
- Software Defined Datacentre
- Software Defined Storage
  - Architecture
  - Example
- Object Storage
- Summary
Popular View of Computing Evolution

- **1st Platform**: Late 1950's to present
  - Thousands of Apps
  - Millions of Users
- **2nd Platform**: Mid 1980's to present
  - Tens of Thousands of Apps
  - Hundreds of Millions of Users
- **3rd Platform**: Early 2010's to present
  - Millions of Apps
  - Billions of Users

Source: IDC, 2013

> 2.4 Billion
Spending on Technologies

Approx 10.6% CAGR

Approx 0.5% CAGR

[Ref: IDC, 2013]
### 2nd Platform vs 3rd Platform Considerations

<table>
<thead>
<tr>
<th>Instead of:</th>
<th>You need:</th>
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<tbody>
<tr>
<td>Enterprise level DC</td>
<td>Hyper scalable DC</td>
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<tr>
<td>System Level</td>
<td>Resource Level</td>
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<tr>
<td>Legacy</td>
<td>Greenfield</td>
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<tr>
<td>Heterogeneous</td>
<td>Homogeneous</td>
</tr>
<tr>
<td>Integrated systems</td>
<td>High to very high density</td>
</tr>
<tr>
<td>Complex Application Portfolio</td>
<td>Singular Application Portfolio</td>
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<tr>
<td>Workload Optimized</td>
<td>Software Defined</td>
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## IT Evolution

<table>
<thead>
<tr>
<th></th>
<th>Older IT</th>
<th>New IT</th>
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<tbody>
<tr>
<td><strong>Responsibility</strong></td>
<td>Create and Operate IT</td>
<td>Create Capabilities to support business objectives</td>
</tr>
<tr>
<td><strong>Challenge</strong></td>
<td>Managing Internal Resources</td>
<td>Deliver Value Thru Dynamic Multi- Sourced Organization</td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td>Owned &amp; Operated by IT</td>
<td>Leverage IT both On/Off premise</td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td>Hierarchical with Functional Skills</td>
<td>Leverage IT and business skills + partners</td>
</tr>
<tr>
<td><strong>KPI</strong></td>
<td>IT Effectiveness (ROI/TCO)</td>
<td>Business Performance (time to service/revenue)</td>
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3rd Platform Infrastructure: Characteristics

**Agility** – adapt to many varying conditions & demands oftentimes concurrently

**Scaleability** – vertical and horizontal on demand (“web-scale”)

**Resilience** – always up, always on, “self healing”

**Management Simplicity**
  - Service Based
  - Hardware Agnostic

3rd Platform (10-15+ years)
Datacentre Infrastructure: Software Defined

- Software Defined DC
- Software Defined Computing
- Software Defined Networking
- Software Defined Storage
- Software Defined Systems Management
- Evolutionary process
Gartner Hype Cycle for Emerging Technologies - 2014

[REF: Gartner's 2014 Hype Cycle for Emerging Technologies Maps the Journey to Digital Business.]
The Storage Layer – Old IT

- Capabilities vary by manufacturer
  - Features are hardware/firmware specific
  - Storage infrastructure becomes whatever that individual vendor provides.
  - Low interplay between major vendors.
- Can be difficult from a scaling and management perspective
- So, what’s the problem??
Modern Apps are Breaking Traditional Storage

Not designed for Cloud and Big Data applications

Architecture is too complex
  Locking, replication, High Availability, geo-distribution is complex

Not Web or firewall friendly
  Distributed (WAN) access is complex

Storage silos impede development
  Different hardware for every data type and access protocol
Storage Needs - Customer Demand
Mapping Needs to Capabilities

- Hardware Independence
- Automated Deployment
- Convergence
- Scaleability IN/OUT
- Erasure Coding
- Non-disruptive upgrades
- VM/API/App based provisioning & management
- Multi-tenancy
A little about Erasure Coding

- Erasure coding - set of algorithms that allows the reconstruction of missing data from a set of original data.
  - Method: stream of data broken into $k$ pieces to which $m$ additional (redundant) pieces are added to yield $n$, hence:
    - $n = k + m$ such that $m < k$
    - Can tolerate $m$ failures
    - Storage Efficiency = $m / (k + m)$
    - Guarantees that any subset $k$ pieces chosen from set $n$ could be used to rebuild the original data.
  - Piece can be entire disks, volumes, parts of disks or devices.
- 2 basic forms
  - Reed-Solomon
    - uses sophisticated linear algebra operations to generate multiple parity cells, and thus can tolerate multiple failures per group
  - Performance oriented variant
- This is the future of stored data
  - $P$(failure of other disks) increases as rebuild time increases.
## Storage Capabilities: Old vs New

<table>
<thead>
<tr>
<th>Old</th>
<th>New</th>
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<tbody>
<tr>
<td>Data Efficiency</td>
<td>Scalability (IN/OUT)</td>
</tr>
<tr>
<td>Data Protection</td>
<td>Erasure Coding / RAID</td>
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<tr>
<td>Disaster Recovery</td>
<td>Multi-tenancy</td>
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<tr>
<td>Data Optimization</td>
<td>Convergence</td>
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<tr>
<td>Data Reduction</td>
<td>VM/App/API-based provisioning &amp; management</td>
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<tr>
<td>Fast deployment</td>
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<tr>
<td>Non disruptive upgrades</td>
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Software Defined Storage (SDS)

- SDS is an approach; it is not a product.
- SDS defines how storage is to be delivered in the future.
- SDS fulfills the promise of abstracting feature and function (capabilities) away from the hardware...only to put it back together again.
- Adaptable to commonly available industry platforms (i.e. COTS hardware)
- Provides high scalability (web-scale/cloud scale)
- Support for most common data storage types:
  - File
  - Block
  - Object
- Two main vendor approaches to SDS
  - New product offerings – SDS ready
  - SDS enablement of older products (tiering to the cloud, etc.)
SDS is about exploiting flexibility and automation in the storage infrastructure to deliver very high degrees of business efficiency and agility.
Putting it back together: 2 approaches

Physical Server
- Just storage
- Centralized and fine tuning of storage
- Specialized expertise required in the data center

Hypervisor
- Storage + Compute
- Storage controlled and managed by the hypervisor/VMs
- All managed by hypervisor or application administrators
SDS is Bundled or Unbundled

**Bundled solutions**
- Integrated solution of HW and SW. Typically shipped as an appliance
- Quick to deploy
- Robust and hardened

**Unbundled solutions**
- Hardware and software are separate products. Sized individually.
- Hardware flexibility
- Lower CAPEX
Getting Ahead Of The Curve

IT Technology Eras

1. Mainframe 1st Platform
2. Client-Server 2nd Platform
3. Mobile-Cloud 3rd Platform

IT at the Speed of Business

Business Expectations
Ability of IT to Deliver
Steady IT Budgets

* Source: Gartner, 2013: "Hunting and Harvesting in a Digital World: The 2013 CIO Agenda"
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## SDS Architecture & Integration Levels

<table>
<thead>
<tr>
<th>Architecture</th>
<th>Bare metal storage</th>
<th>Traditional storage stack</th>
<th>Integrated partner storage OS</th>
<th>Installable storage OS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full R&amp;D integration</td>
<td>Factory-integrated</td>
<td>Reference Architecture/HCL</td>
<td>Installable hyper-convergence SW</td>
</tr>
</tbody>
</table>

- **Level of integration**: More integrated → Less integrated
ViPR Controller

ViPR Services

Storage Arrays

Commodity Platforms

Make Managing ALL Platforms Simple
Elastic Cloud Storage (ECS)
ECS Dashboard

Dashboard

Capacity

- Usable: 100.0 GB
- Available: 23.0 GB
- 23%

Performance

- Read Latency: 112 MB/sec
- Read Bandwidth: 145 MB/sec
- Write Latency: 187 MB/sec
- Write Bandwidth: 201 MB/sec

Data

- Customer Data: 100.0 GB
- System Data: 23.0 GB

Geo Monitoring

- RPO: 3 hrs
- Data Pending Geo-replication: 23.0 GB
- Replication Rate: 10 MB/sec

Node & Disk Health

- Nodes: 10
- Disks: 1000
- Failover Progress: 47%

Storage Efficiency

- Data for EC: 100 GB
- Data Pending EC: 10 GB
- Rate of EC: 80 MB/sec

Alerts

- Critical Alerts: 18
- Warnings: 12
Object Storage

- Object includes the data itself, a variable amount of metadata, and a globally unique identifier. Manage the data as objects.
- Implementable at: device level (object storage device), the system level, and the interface level
- Object storage enables enhanced capabilities:
  - application programmable interfaces
  - namespace that can span multiple instances of physical hardware
  - data management - replication and data distribution at object-level granularity.
- Examples:
  - Amazon Web Services S3
  - Rackspace Files (aka OpenStack Swift)
  - Microsoft Azure
  - Google Cloud Storage
  - Oracle Elastic Storage Service
  - DreamHost DreamObjects based on Ceph.
There is a standard for OSDs under ANSI INCITS T10 (the SCSI specification)

- ANSI INCITS 458-2011
- OSD-1 is basic functionality
  - Read, write, create, delete objects and partitions
  - Security model, Capabilities, manage shared secrets and working keys
- OSD-2 adds:
  - Snapshots Collections of Objects
  - Extended exception handling and recovery
Object Storage Device (OSD)

- OSDs hold objects, which are like files in a simple file system
  - Objects are dynamically created and freed
  - Object are variable length
  - Objects have extensible attributes
  - Objects are identified by a 64 bit Object ID (OID)
- Objects in an OSD are grouped within partitions, which are identified by a 64 bit Partition ID
- 64 bit OID plus 64 bit PID gives a 128 bit namespace
- OSDs manage space allocation of Objects
  - A 4TB disk has 1 billion 4KB blocks – OSD hides this
Object Storage Constructs

Tenant, Project, Secret Key

Object Virtual Pool

Data Store
File Virtual Pool

VIRTUAL ARRAY

ECS
ECS
ECS

ECS
ECS
ECS

VIRTUAL ARRAY

VNX 5500
Isilon
3rd Party
Summary

- CAPEX and OPEX in traditional IT cannot be optimized given the demands of new applications, data, devices and wide-geo users, hence need for 3rd platform Infrastructures.
- Core of IT (3rd platform) is the Datacentre. Software defined Datacentre must become very real, very fast.
- 3rd platform redefines lots of roles, especially, CIO, IT support, operations, capacity planning & performance folks.
- Achieving agility is a long process with dependencies on efficient automation and virtualization.
Thank You