OPEN HYPERCONVERGED INFRASTRUCTURE

Presenters
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Date 06.24.15
Your Presenters

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  • Technical Mktg lead with the Storage BU
INTRODUCTION
AGENDA

- The What & the Why
- Under the Hood
- Q&A
SETTING THE STAGE

• Red Hat is an enterprise infrastructure provider
  • Always looking thru a next-gen IT *solution* lens

• HCI space is H-O-T

• We are working upstream toward oVirt / Gluster HCI integration
The What & Why
The What

Hyper-convergence

- Collapse compute, storage into small footprint
  - ...scalable resource pool, with redundancy / high availability
  - ...eliminate the need for discrete components
- Value Prop is centered around simplicity, TCO
- User profile – mid-market to large enterprise

oVirt-GlusterFS

- Toward an Open Source Hyperconverged platform
  - ...Linux, oVirt, Gluster - integrated.
The What

A proven, general purpose scale-out distributed storage
- Unified namespace, supporting thousands of clients
- Gluster runs completely in user space

oVirt-Gluster Integration
- Native Gluster Storage Domain type
- Enable Volume Management from oVirt WebAdmin and REST-API
In a word: Simplify!

- Single team managing infrastructure
- Simplify ITIL flows, improve project delivery turnaround
- Simplify hardware planning, procurement
- Simplify hardware deployment, mgmt
- A ‘level playing field’ for capex
- Single budget provides compute and storage
- Hardware flexibility = no lock-in

Why?

“why it just makes sense”
Why?
The market & the goods

User / Market Demand
- From SMB to Enterprise - planning, deploying
- Hot market, with growing demand for an open HCI value prop
- HCI market grew 162.3% in 2014 (to a market value of $373 million)
- Forecast: up 116% in 2015 (to reach $807 million)
  ...within two years, over 50 percent of enterprises across all sectors will use some form of HCI to run their VMs

Best of Breed Components (greater than the sum of the parts)
- oVirt a robust Linux virt platform
- Gluster technology an industry-proven distributed storage system
UNDER THE HOOD
SOLUTION STRATEGY

- Systemd resource management
- Data security
- Multiple layers of cache
- QoS features (disk profiles)
- Libgfapi support in qemu-kvm optimizes the i/o path
- Offload data reconstruction to hardware
- Hardware freedom/choice
- Auto data rebalance
- Mixed SATA/SAS and SSD
COMPONENT OVERVIEW

- oVirt 3.6.x
- RHEL 7.x
- LVM
- SSD managed by dmcache
- Hardware RAID
- Glusterfs 3.7.x provides the data layer
- libgfapi
- Synchronous 3-way data replication
- OpenSSL
- Commodity x86-64 servers
GLUSTERFS FEATURES
GLUSTERFS IN A NUTSHELL

Top 5 features:

- elastic volumes - grow and shrink, non-disruptively
- automatic self healing
- modular, userspace architecture based on *translators*
- synchronous replication
- no central meta-data server = no single point of failure
DATA PLACEMENT

elastic hash algorithm generates a hash value from a file path

each brick within the cluster is assigned a hash range

the client is aware of the hash ranges from each brick

direct data path

each file holds metadata in xattr
First read generates a pre-op request to each brick that owns the vdisk
first to respond is the winner!
local brick on the executing node is chosen
reads focus on the local brick
in the event the local brick is lost, failover to one of the other bricks is automatic
DATA LOCALITY… IN ACTION

RHEL7 vm running fio
- 128k block
- Synchronous
- directio
- 10g file test file

vm live migrated during benchmark run

transition of the brick servicing I/O matches the vm’s host
DATA INTEGRITY

Data must be protected across nodes at all times

All writes MUST be written to multiple nodes

glusterfs does this using synchronous replication
DATA INTEGRITY... IN ACTION

100% write workload

fsync across systems are well aligned

ensures 3 copies of the data are consistent and available
DATA RECOVERY – AUTOMATED SELF HEAL

Maintain Data Redundancy

- grace period or timeout
- data re-replicated

Considerations

❌ available capacity is reduced
❌ re-replicate may represent additional workload
❌ problematic for small clusters

Limit impact to active workload

- track changes
- apply changes when node/disk is available again
- more usable capacity

Considerations

❌ during the outage, data redundancy goal is not met
❌ self heal only starts once the node or replacement is brought back into the cluster
PERFORMANCE FEATURES
EXPLOITING CACHE

physical I/O = latency
write latency can’t be avoided
cache reduces read latency
all vdisks are files...vfs
cloned disks may fit in page cache
dmcache supports random read
CACHE EFFECTS

Test Conditions

- Single vm
- fio random read workload
- 8k blocksize
- sync / directIO
- single thread
- 10g dataset

buffer hits : < 0.5ms

disk I/O : ~ 5-6ms

warm dmcache : <=1ms
## MEASURING CACHE EFFECTIVENESS

```bash
[root@hypervisor1 ~]# pcp -h localhost dmcache
@ Mon Jun  8 20:02:45 2015 (host hypervisor1.lab.redhat.com)
```

<table>
<thead>
<tr>
<th>meta cache</th>
<th>hit</th>
<th>miss</th>
<th>ratio</th>
<th>reads</th>
<th>hit</th>
<th>miss</th>
<th>ratio</th>
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<tbody>
<tr>
<td>Bricks-raid5</td>
<td>0.7%</td>
<td>7.3%</td>
<td>425.49</td>
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<td>97.5%</td>
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<td>97.2%</td>
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<tr>
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<td>0.00</td>
</tr>
<tr>
<td>Bricks-raid5</td>
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<td>7.3%</td>
<td>354.49</td>
<td>16.79</td>
<td>95.0%</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Bricks-raid5</td>
<td>0.7%</td>
<td>7.3%</td>
<td>332.97</td>
<td>6.92</td>
<td>98.0%</td>
<td>0.00</td>
<td>0.00</td>
</tr>
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<td>7.3%</td>
<td>326.73</td>
<td>7.90</td>
<td>96.8%</td>
<td>0.00</td>
<td>0.00</td>
</tr>
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</table>
SECURITY CONSIDERATIONS
PROTECTING VIRTUAL DISKS

Vdisks accessed via a network

- Non-routable VLAN
- auth.allow

Data path encryption

The cpu cost of encryption

Security headache becomes a planning exercise
I/O LATENCY IMPACT*

64k random read test
(cached in buffer/dmcache)

* More validation to come!
MANAGEMENT CONSIDERATIONS

- Management engine options;
  - self-hosted running natively on glusterfs
  - remote options
- Dashboard provides an “at a glance” view
- Storage and compute managed within a single interface
- New disks added through the UI
- SSD integration is read only
THE DASHBOARD VIEW

- **ALL CLUSTERS**: 4 clusters
- **CAPACITY**
  - Total: 23.60 GB
  - Free: 23.22 GB
  - Used: 389.67 MB
  - Used: 61%
- **ALERTS**
  - CPU: 6.1%
  - Memory: 11.5%
- **HOSTS**: 8
- **VOLUMES**: 3
- **NIC**: 10
- **NETWORK**
  - Transmit: 0 Bytes
  - Receive: 0 Bytes

Last Message: 2015-Jun-11 20:09, User admin@internal logged in
- 2015-Jun-11 20:02, User admin@internal logged in
- 2015-Jun-11 20:05, User admin@internal logged in
- 2015-Jun-11 15:32, Found new storage device vg_dhcp432-0_swap on host RHGS-8, and added it to engine DB.¹
- 2015-Jun-11 15:32, Found new storage device vg_dhcp432-0_root on host RHGS-8, and added it to engine DB.²
- 2015-Jun-11 15:32, Found new storage device vg_dhcp432-0 on host RHGS-8, and added it to engine DB.³

¹ https://dhcp432-03.lab.eng.blr.redhat.com/ovirt-engine/webdmi/#/hosts
² https://dhcp432-03.lab.eng.blr.redhat.com/ovirt-engine/webdmi/#/hosts
³ https://dhcp432-03.lab.eng.blr.redhat.com/ovirt-engine/webdmi/#/hosts
DISK MANAGEMENT
ADMINISTRATION

- Web GUI (oVirt)
- REST / API
- oVirt python SDK + gluster bindings for libgfapi
- Integration example - vm2brick tool
- Support Tools
  - Performance co-pilot
  - dmcache CLI reports
  - Common sysadmin perf tools (e.g., iostat, vmstat, iotop)
  - Ovirt data warehouse for reporting, trending, analysis

1https://github.com/pcuzner/vm2brick
NEW GLUSTERFS FEATURES
FEATURES JUST LANDED IN v3.7

Glusterfs 3.7.x introduces

- Sharding - enhanced granularity for
  - self heal
  - rebalance
  - geo-replication
  - arbiter volumes
  - rebalance performance enhancements
  - multi-threaded epoll

...and more! [1]

FEATURE FOCUS - SHARDING

- shard is a translator that sits client-side
- configurable shard size (default 4MB)
- larger files = more shards = wide striping
- shards get distributed across bricks like normal files
FEATURE FOCUS – ARBITER VOLUMES

The challenge of distributed storage;

- with only 2 copies - split brain is possible
- with 3 copies - costs go up!

Rather than consume more space, let’s address the problem
- 2 copies of the data is a must!
- tie-breaker is needed to avoid split brain
DEPLOYMENT SCENARIO
POTENTIAL GROWTH MODEL

Configuration Phase: Growth Increment #4

<table>
<thead>
<tr>
<th>Hypervisors</th>
<th>Raw Capacity (VMs)</th>
<th>Usable Capacity (VMs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>108TB</td>
<td>36TB</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Replica sets</th>
<th>Bricks</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>18</td>
</tr>
</tbody>
</table>

Legend:
- OS
- Hot Spare
- Unused HDD Slot
- 10k HDD
- SSD
- Capacity Increment
- empty drive bays
Further Info...

- http://www.ovirt.org/Features/GlusterFS-Hyperconvergence
- https://fosdem.org/2015/schedule/event/hyperconvergence/
Q&A
LEARN. NETWORK.
EXPERIENCE OPEN SOURCE.