Nutanix, AHV and Performance

Dr Felipe Franciosi
AHV Engineering Lead
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Agenda

1. Nutanix Enterprise Cloud Platform
2. Open Source at Nutanix
3. Acropolis Hypervisor
4. Next Steps in Performance
Nutanix

Nutanix delivers software-defined hyperconverged infrastructures

Fast Facts

• Founded in 2009
• 4,000+ Employees (1,000+ Engineers)
• 10,000+ Customers
• Presence in 145 Countries
• HCI Leader (Gartner MQ 2018, Forrester Wave 2018)
• NASDAQ: NTNX
• Net Promoter Score: +90
Broad Customer Adoption
Data Centre Management is Painful
Modern Data Centre

Integrated, scale-out compute and storage with built-in virtualisation and management
Traditional vs Modern Data Centre

Function-specific Hardware (Hardware-Defined Data Centre)
Expensive, Inflexible

Commodity Hardware (Software-Defined Data Centre)
Inexpensive, Flexible

source: Invisible Infra 10/02/2013

source: Le Monde Informatique 13/10/2015
Nutanix: Behind the Scenes
Nutanix: Behind the Scenes

Acropolis Distributed Storage Fabric

CVM

hypervisor

SSD
HDD

CVM

hypervisor

SSD
HDD
Nutanix: Behind the Scenes
Nutanix: Behind the Scenes
Nutanix: Behind the Scenes
RAID controllers don't make sense at our scale; everything is redundant at higher levels. When a drive fails, we just throw away the whole machine.

Machine? We throw away whole racks at a time.

Yeah, who replaces one server?

We just replace whole rooms at once. At our scale, messing with racks isn't economical.

Wow, like Google!

We don't have sprinklers or inert gas systems. When a datacenter catches fire, we just rope it off and rebuild one town over.

Makes sense.

I wonder if the rope is really necessary.
Nutanix: The Acropolis Hypervisor (AHV)

Acropolis Hypervisor

- Virtualisation Appliance based on CentOS 6.9
- Uses Various Open Source Projects
  - Linux Kernel 4.4 LTS (KVM)
  - Qemu 2.6
  - Libvirt 2.0
  - Open vSwitch 2.5.2

- Nutanix contributes to Open Source
  - Live Migration Improvements
  - Virtualisation Features
  - Security/Functional/Test Fixes
AHV: Live Migration
AHV: Live Migration Performance

Migration of a 'Dirty Harry' VM with 32GB of RAM and 8 vCPUs
(Workload using 30GB Dataset and 8 Dirty Threads)
qemu-2.3.0-nutanix (from AHV Asterix 20160925.50)
AHV: Live Migration Performance

Migration of a 'Dirty Harry' VM with 32GB of RAM and 8 vCPUs
(Workload using 30GB Dataset and 8 Dirty Threads)
gemu-2.6.0-nutanix (from AHV Master)
AHV: Live Migration Performance

Migration of a 'Dirty Harry' VM with 32GB of RAM and 8 vCPUs
(Workload using 30GB Dataset and 8 Dirty Threads)
qemu-2.6.0-nutanix (from AHV Master) - dirty_rate_high_cnt - unnecessary iteration
AHV: Live Migration Performance

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qemu-2.3.0-nutanix (from AHV Aterix 20160925.66 - ca77019a)
AHV: Storage Performance

NVMe drives are highly parallel and very fast

- Require high request size for top throughput
- Require high queue depth for top IOPS
- Require multiple cores to drive top performance

Very challenging for hypervisors

- For CPU efficiency, require either:
  - Entire userspace stacks (e.g. SPDK)
  - Hardware offload (e.g. SmartNICs)
- Both methods need "datapath transfer"

VM using Debian 9.4 guest, 8 vCPUs, 32GB vRAM, FIO 2.16
Host using Qemu 2.6 with virtio-scsi and AHV 20170830
AHV: Storage Performance
AHV: Storage Performance

Storage Workload

virtio-scsi

vCPU
vCPU

Datapath Handler

BLK

nvme

guest's memory

virtio-scsi

vCPU
vCPU

Guest's memory

VQ Handler

VQ Handler

guest's memory

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AHV: Storage Performance

Storage Workload

virtio-scsi

Datapath Handler

VQ Handler

SPDK

Qemu

guest's memory

vCPU

vCPU

Qemu

guest's memory

vCPU

vCPU

virtio-scsi

virtio-scsi
AHV: Storage Performance

Does it really make a difference?

- Datapath offload enables various optimisations
- Separate process can handle IO more efficiently
- SPDK backend achieves bare metal performance
- Require multiple VM cores to drive top performance
  - Inefficient virtio-scsi implementation (kernel)
AHV: Storage Performance

Does it really make a difference?

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Driving virtio-scsi from guest

- Entire userspace stack all the way from the guest
- Bypasses kernel in the guest and hypervisor

VM using Debian 9.4 guest, 8 vCPUs, 32GB vRAM, FIO 2.16
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We ❤️ Open Source
Thank you