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SSD and Container Native Storage for High-Performance Databases

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Agenda – There *Will* Be Math*

1 Databases ∩ Containers = Null Set?

2 Integral(VMs dt) = DevOps(Containers)

3 Software Defined Storage + Containers > SAN

4 Lim Performance(CNS + SSD)|DBs->128

5 Databases / (SSD + Containers) = ∞ Possibilities

* But there *is* a study guide available at:
https://red.ht/cns-mysql-performance-paper

Databases ∩ Containers = Null Set?

Challenge: Databases in containers

- Software ate the world. Containers ate software…

- But the databases that containers rely on are still on dedicated hardware.
  - Performance
  - Persistence

- **Challenge: Integrate Containers and Database**
  - Enable DevOps advances for databases
  - Provide persistent, high performance storage
  - Remove need for database system silos

Integral(VMs dt) = DevOps(Container)

*From VMs to Containers and DevOps*

- VMs (Virtual Machines)
  - VMware®, Hyper-V, KVM, Xen
  - Emulate entire hardware and run full software stack
    - Full Operating System and support software!
    - One VM host could have 100 copies of the Linux® kernel active
  - Per-VM limits on CPU, memory, network, I/O
  - Maximizes isolation of apps

- Containers
  - Split a single OS image into multiple domains (containers)
    - Only one kernel (Windows, Linux) active
  - Each application or executable can have CPU, mem, etc. limits
  - Maximizes density of apps / hardware
  - "DevOps" focused, very fast to deploy and manage

SDS + Containers > SAN

Architecture for persistent storage in a unified cluster

- Software defined storage system (SDS) for persistence
  - Keep storage control and management in-cluster
  - Remove need for external persistent storage
  - Keep control in DevOps' hands

- Run everything under Virtualization
  - KVM, VMware (this example), public cloud, etc.
  - One software-defined storage VM/node with SSD connection
    - Ensure appropriate CPU, memory, networking resources
  - One container node with ephemeral and SDS connections

⋮
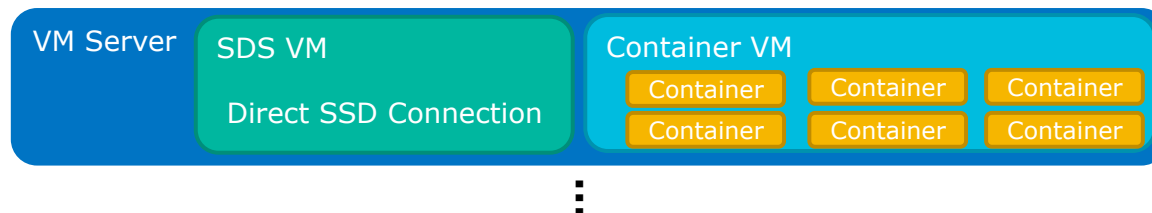
SDS + Containers > SAN^2

Red Hat® OpenShift and Ultrastar® SS200 Under VMware

- Software
  - VMware vSphere® virtualization management
  - Red Hat OpenShift Container Storage (OCS)
    - SDS = GlusterFS, optimized for containers
  - Red Hat OpenShift Container Platform (OCP)
    - Container orchestration
  - Oracle MySQL™
    - Running DVDStore2 Test (part of VMmark™ testbed)
    - I/O intensive, transactional operations
  - 3 SDS VMs

- Hardware
  - 9 HPE ProLiant Servers
  - 15 Western Digital Ultrastar SS200 SAS SSD (5 per SDS VM)
  - (also tested with 36 Ultrastar He10 HDDs)
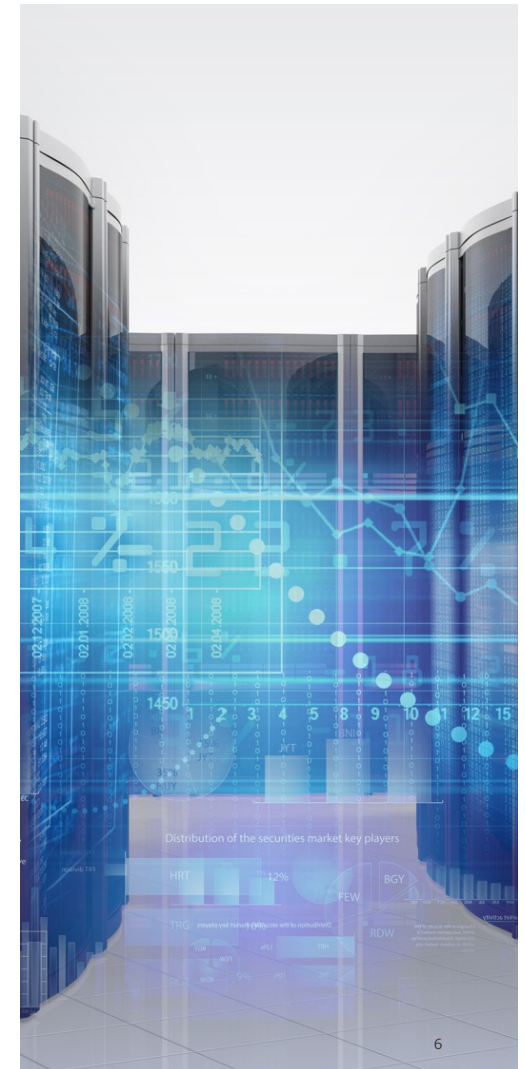
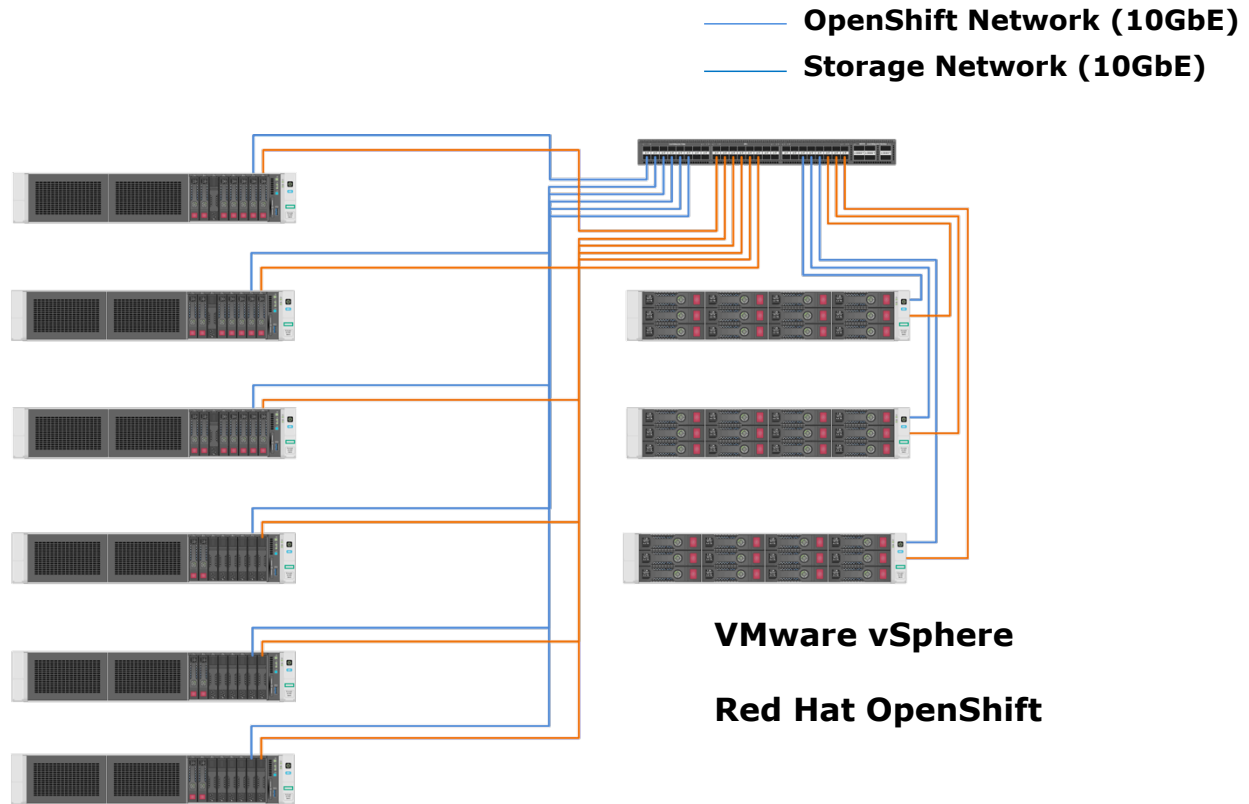# Container Native Storage + SSD = f(ast)

System Diagram

OpenShift Network (10GbE)

Storage Network (10GbE)

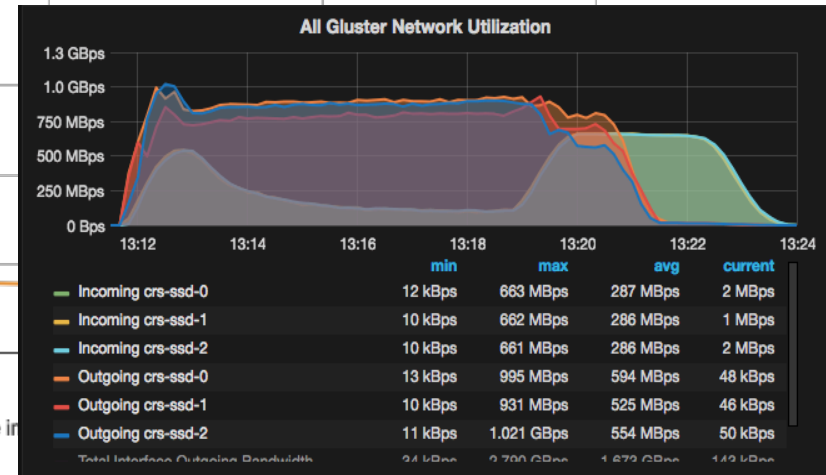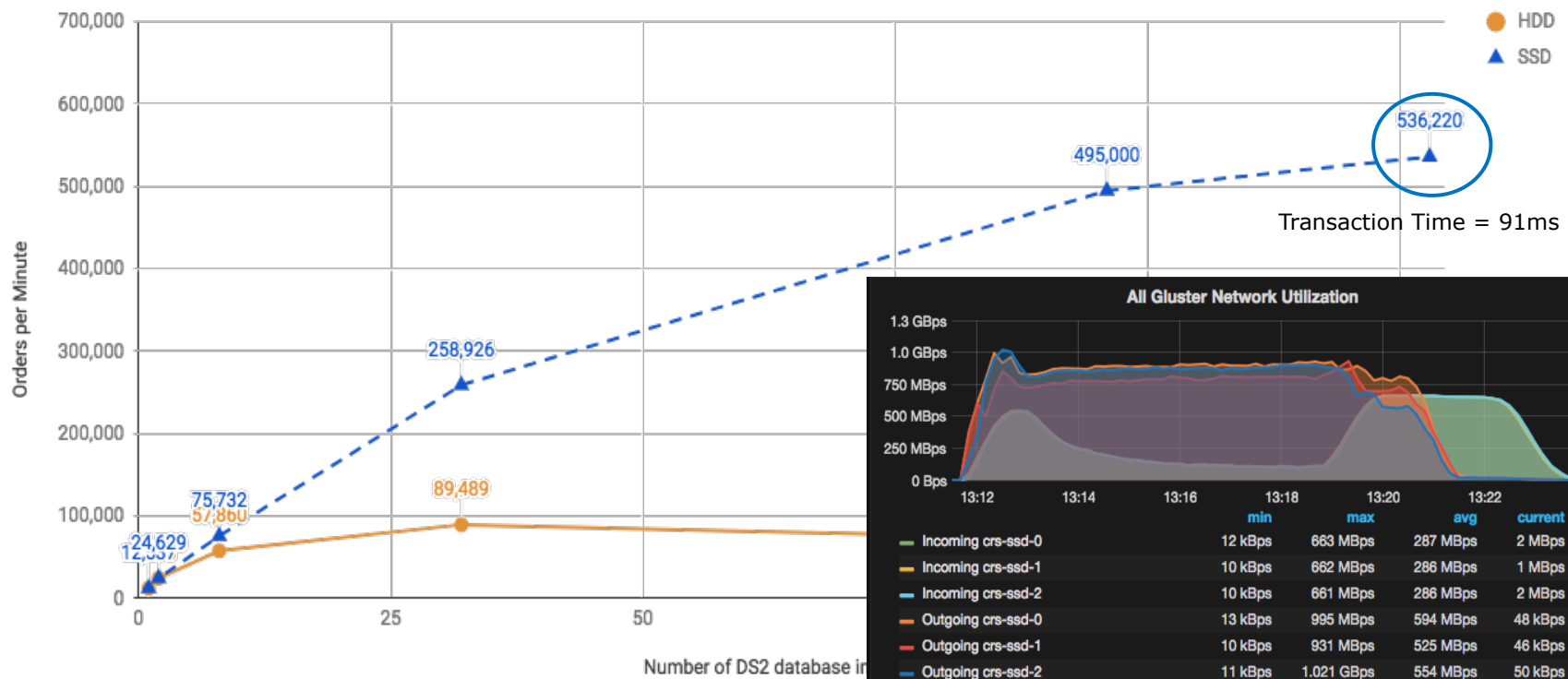**HPE ProLiant
DL380 Gen9 SFF**

- 2x Intel® E5-2697A v4
- 256 GB of RAM
- 5x HGST Ultrastar® SS200 1.9T
- HPE SmartHBA H240ar

VMware vSphere

Red Hat OpenShift

Lim Performance(CNS + SSD)|DBs->128

Test Results

Transaction Time = 91ms

Databases / (SSD + Containers) = ∞ Possibilities

- Challenge: Integrate Containers and Database

- Solution: SDS with SSD in an integrated environment
  - Red Hat OpenShift Container Storage (OCS)
  - Red Hat OpenShift Container Platform (OCP)
  - Western Digital Ultrastar SSDs

- Benefits:
  - Enable DevOps for databases, with performance
  - Provide persistent, high performance storage
  - Remove need for database hardware silos

    Study Guide: https://red.ht/cns-mysql-performance-paper

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