Dragon Slayer

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T E C H N I C A L   P A P E R

# Why KVM is Winning Over VMware vSphere

Why KVM is Winning Over VMware vSphere

Introduction

It's hard to believe that it wasn't all that long in the past that most IT applications were run directly on physical servers. Those physical servers predictably ran about 85% idle most of the time, especially x86 servers. Data centers and server rooms were becoming overrun with server sprawl. Focus was on putting more physical servers in less space. Blade servers were all the rage. Data center power was becoming a major issue. Seems like a lifetime ago.

All that changed during the 2000s. Server virtualization enabled oversubscription of hardware. It became common to oversubscribe the hardware more than 100% because it was statistically rare for all or even most virtual machines (VM) to be demanding resources concurrently. The cost savings proved to be enormous making server virtualization an industry standard practice. So much so that per Spiceworks state of the virtualization industry in 2020, more than 92% of all businesses are virtualized with another 5% planning to virtualize within 2 years. Server virtualization has been the primary technology enabler for public clouds, although that appears to be shifting to containers or application virtualization. More on that later in this research paper. It is absolutely clear to the most lay observer that server virtualization is ubiquitous today.

VMware vSphere is the current on-prem market leader each business size category – SMB, Mid-tier, and
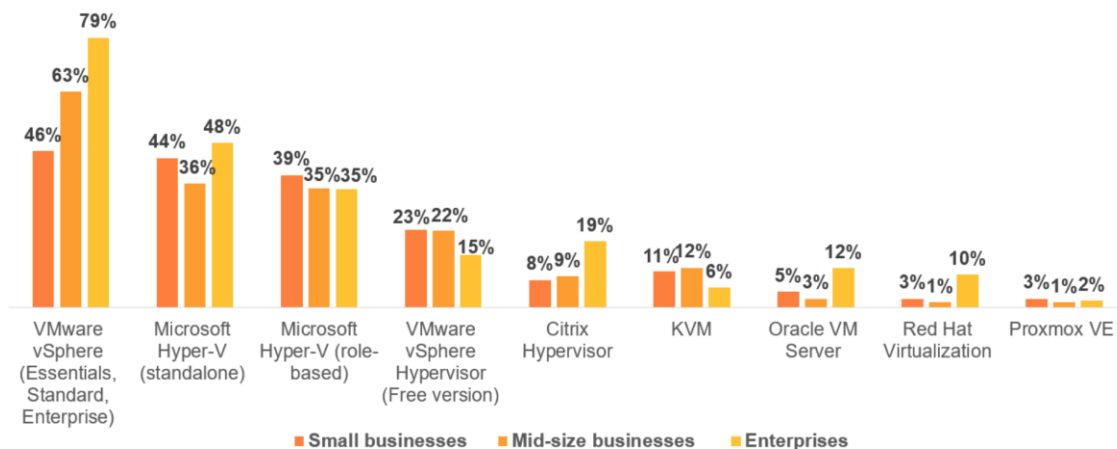
Enterprise – per that Spiceworks survey. This is mostly because it was the first to bring server virtualization to the masses with standard x86 servers. Its popularity grew thanks to advanced capabilities it introduced such as application isolation, enhanced workload portability, augmented scalability, top of rack virtualization, storage virtualization, simple high availability options, integration with backup applications, and disaster recovery options. These advances enabled IT businesses to deploy faster, greatly improve application availability, while operating and managing more efficiently with lower capital expenditures (CapEx). So then how can it be asserted that KVM winning if VMware is the predominant hypervisor? Especially since those current market share numbers make that leadership crystal clear.

VMware vSphere cost savings have been lost over time. Licensing costs and the proprietary lock-in nature of VMware have become increasingly much larger parts of the IT budget. It has been causing elevated anxiety levels among CIOs and CFOs. IT organizations are under constant pressure to reduce costs without reducing capabilities. Hypervisors are not immune to that pressure. Those costs have become an enormous issue for every IT organization tasked with doing more with less.

Many evaluated and switched to or added Microsoft Hyper-V hypervisor as a lower cost alternative to VMware vSphere. However, that cost differentiation proved to be insignificant.

KVM is an increasingly popular open source hypervisor. It's part of the Linux kernel and distributed with Linux. There are no license costs for KVM just as there are no license costs for Linux. The only direct costs of KVM are distributor support costs unless the IT organization wants to handle support on their own. KVM

has additional indirect cost savings over VMware vSphere. The combination gives KVM a significant cost advantage over VMware and vSphere right out the chute. That's an important reason KVM is winning right now in the market but far and away not the only one. Price is always a factor. Total cost of ownership (TCO) is the much bigger factor.

There are also several other significant factors as to why KVM is rapidly overtaking the market. This paper takes a deeper dive into those factors where KVM has the advantage and how the additional advantages of the Oracle Linux KVM distribution plays a significant role in why KVM is winning over VMware vSphere.

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Significant KVM Advantages over VMware vSphere

KVM has several advantages including being open source, performance, scalability, hardware resources utilized, and total cost of ownership (TCO).

KVM Open Source Advantage

The open source movement started towards the very end of the 20th century. Despite initial skepticism, it has become wildly successful by any measure. It is now a staple in most business organizations. Per Simon Phipps, former president of the Open Source Initiative, 78% of businesses are operating on open source software and that number is increasing.

KVM has been part of the Linux kernel since 2007 and is part of the Linux distribution. Some say that makes KVM a type 2 hypervisor that runs within the OS. That's incorrect. It can fool administrators because a Linux user can start KVM from a command line or GUI. Linux launches KVM establishing a co-processing relationship in which KVM shares physical hardware control with the Linux kernel. But KVM uses the x86's virtualization instructions to allow KVM and its guests to run directly on the bare metal. Thus, making KVM a type 1 hypervisor. Close integration with Linux is a key reason Linux developer generally prefer KVM.

One of the pre-eminent open source initiatives has been Linux. Linux was introduced in 1990s. The 1990s was a time of Microsoft operating system dominance with several UNIX variants in the distant "other" category of market share. Times have certainly changed. As of 2019, with the exception of desktops, laptops, and tablets, Linux is the dominant operating system in the world. Per HostingTribunal.com, Linux runs:

- 100% of the world's top 500 supercomputers
- 96.3% of the world's top 1 million servers
  - 1.9% use Windows
  - 1.6% use FreeBSD
- All major space programs
  - SpaceX Falcon 9, their primary rocket, runs on Linux
- 90% of all cloud infrastructure
- 90% of all Hollywood's special effects
- 23 of the top 25 world websites
- US Department of Defense since 2007 because of better security and lighter load
- US Navy warships
- And more than 85% of the world's smartphones – Android is a modified version of Linux
- Linux is the largest and most successful open source project

The numerous advantages of open source include but are not limited to the following:

- Free distribution
- Multi-vendor, multi-source innovation
- Modern software development practices
  - Developers rarely write open source into old code
- Modular design
- Focuses developers on core competencies
- Reduces duplication efforts
  - No need to reinvent the wheel
- Leverages large company R&D works
- Available source code
- Allowable derived works
- Author's source code integrity
- No discrimination against persons or groups
- No discrimination against fields of use
- Redistribution maintains all rights
- Large community support
- Easy integration with other open source projects such as
  - Ansible
  - Kubernetes containers

- Freedom to change support vendors – i.e. no vendor lock-in
- Freedom to self-support
- License not specific to a product
- License does not restrict other software
- License is technology neutral neither favoring nor discouraging specific technologies

KVM open source leverages all of these advantages. It's why has become ubiquitous in the cloud. Oracle Cloud Infrastructure (OCI), AWS, Alibaba, GCP, IBM and most other clouds utilize some variation of the KVM hypervisor. Even Nutanix hyperconverged infrastructure Acropolis™ hypervisor is a variation of KVM. Oracle KVM is additionally is a true hybrid in that on-prem implementations can be configured identically to what Oracle utilizes in its own Cloud Infrastructure. More on this later.

VMware vSphere is a proprietary closed system hypervisor. It's completely under the control of VMware and locks-in users.

KVM Performance Advantage

Both KVM and VMware vSphere are type 1 hypervisors and outperform any type 2 hypervisor. There are a few published performance comparisons of the two hypervisors with SPECvirt_sc2013. Based on this standard benchmark, KVM runs applications faster than any other hypervisor including VMware vSphere, at near native speeds.

In addition, KVM takes much less time to start a virtual server than VMware vSphere. It also has lower overhead because it is relatively light with approximately tens of thousands of lines of code whereas VMware vSphere is believed to have more than 6 million lines of code. This is unverifiable since VMware does not publish the source code for vSphere because it is proprietary. The vSphere performance is only marginally affected because of the use of hardware extensions to virtualize VMs.

One of the reasons for KVM's better performance comes from the Linux kernel real-time extensions. These extensions enable VM applications to run at lower latency with higher prioritization as compared to bare metal. The Linux kernel also divides long compute time processes into smaller components, that are then scheduled and processed faster.

KVM Scalability Advantage

KVM has a significant scalability advantage over VMware vSphere. It's one of the reasons why it's the hypervisor of choice for hyperscalers and cloud service providers.

Scale Limits	Oracle Linux KVM	VMware vSphere ESXi 6.7
Max hosts/cluster	128	64
VMs/host	600 Tested, but real limit is significantly higher	1,024
vCPUs/VM	256	128

KVM TCO Advantage

KVM has several cost advantages over VMware vSphere. It starts with licensing. There is none. Yes, there are support costs whether from the KVM distributor or internal administrators. Those costs are also less than VMware vSphere. VMware requires the purchase of licenses for add-on products and features such as VSAN (virtualized storage) and NSX (virtualized switching). The licensing generally requires an Enterprise license agreement (ELA). The ELA can save some budget up front while increasing costs over time as capacity and functionality are added. VMware has a free variation of that just has support costs. It is meant for low end users to compete with KVM. However, the free is functional but stripped of the most useful and commonly utilized features. It's designed to motivate users to the license version.

Other cost savings include reduced hardware, supporting infrastructure hardware, power, cooling, management, operations, and troubleshooting time costs.

Oracle Linux KVM Unique TCO Advantages

Oracle Linux KVM brings substantial unique TCO advantages. There are several meaningful, useful, time, and cost saving advantages.

Hard Partitioning

Hard partitioning enables a VM application to be CPU pinned. Hard partitioning means binding virtual CPUs (vCPU) to physical CPU threads or cores and preventing these vCPUs from being scheduled on physical CPUs - threads or cores other than the ones specified. This is crucially important when it comes to minimizing application licensing. Application licensing or subscriptions are commonly based on vCPUs. For Oracle software and several other Enterprise applications, those costs are based on all potentially available vCPUs and not just the ones the application is running on. If that application can be shifted to other vCPUs via policy, the license costs go up. This applies to the Oracle Database, Oracle Fusion Middleware, and Oracle's applications. Hard partitioning reduces those license costs by multiple factors.

Neither VMware vSphere nor any other KVM distribution is recognized by Oracle software as delivering valid hard partitioning. Oracle Linux KVM uniquely creates value by managing and reducing Oracle software license costs.

Oracle Linux Ksplice Zero-Downtime Patching

Ksplice solves a major costly problem. Patching a hypervisor is non-trivial because it's frequently disruptive to all of the VMs and applications that it is supporting. Disruptive processes require scheduling. Few applications can tolerate an outage during business hours. Most IT organizations schedule vulnerability patching disruptive processes for a weekend sometime within a 90-120-day timeframe[1]. Patching is put off so the different stakeholders, applications, servers, hypervisors, storage, networking, etc., have time to coordinate their efforts. When that scheduled date rolls around, assuming it hasn't been deferred, the first 24 hours is when all disruptive patch processes are implemented. The next 24 hours is reserved to back out the patches that didn't work or caused problems. These processes are labor intensive and error prone.

Until those vulnerabilities are patched, they are subject to exploitation. Make no mistake, cybercriminals are doing their best to exploit them. The potential costs of exploitation can be enormous in lost productivity, lost data, lost revenue, lost income, lost customers, lost reputation, and potential non-compliance fines.

Oracle's unique[2] Ksplice technology and service updates the kernels, KVM, and critical user space libraries without requiring a reboot or interruption. This means when a patch is released, including patches for exploitable vulnerabilities, Ksplice enables those patches to be implemented quickly in a timely manner, without having to be scheduled or coordinated with anyone.

As previously mentioned, the Oracle Cloud Infrastructure (OCI) utilizes Oracle Linux KVM. When Oracle upgraded their previous OCI gen 1 to OCI gen 2, they took full advantage of Ksplice. Disrupting thousands of applications in the cloud would be disastrous. Oracle documented that they were able to implement 150 million patches – some for the Spectre and Meltdown CPU vulnerabilities to more than 1.5 million CPU cores without disruption. It was all done online in approximately 4 hours with zero downtime.

Neither VMware vSphere nor any other KVM distribution, not IBM Red Hat, not SUSE, nor Ubuntu, have Ksplice. Oracle is the only KVM distribution that solves this patching problem. And the cost savings are enormous in time, people, disruptions, and potential malware/ransomware exploitations.

Native Bi-directional Cloud Migration

Oracle Linux KVM users can choose to configure on-premises virtualization the same way it's configured within the Oracle Cloud Infrastructure or other Oracle products that use KVM. This makes it incredibly simple to move VMs between on-prem and the cloud or vice versa. Configuring this way eliminates a major

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[1] Verizon 2020 DBIR reports only half of the vulnerabilities are patched within three months after discovery.
[2] Red Hat has Kpatch and SUSE has kGraft which are somewhat similar to Ksplice, but only for the kernel and a small patch subset. Ksplice has a much broader range of patches including the ability to patch hypervisors and critical user space bits non-disruptively.

devops headache when developing in the cloud for on-prem deployments. The developers can be assured that how they see their application run in the Oracle Cloud Infrastructure will run the same on-prem without changing their code.

It's important to note that with the exception of Oracle, no other current major public cloud provider shares their hypervisor for on-prem usage. Similarly, with the exception again of Oracle, no other Linux KVM distributor vendor, including IBM Red Hat, have been utilized by major public cloud providers to deliver cloud services.

Accelerated Application Deployments

Oracle offers an innovative approach to deploying a fully configured software stack with pre-installed and pre-configured software images. Use of these virtual machine templates significantly reduces admin time to install, configure, implement, and manage. Time is money. Reduced admin time equates into much reduced costs. Saved time can be repurposed for more strategic developments that help accelerate application development as well. Faster application deployments mean faster time to market which helps generate additional revenues in addition to the lower operational costs.

Comprehensive Management Tools

The Oracle Linux Virtualization Manager (OLVM) is based on the open source oVirt project. Oracle Linux Virtualization Manager is easily deployed and makes it incredibly simple to configure, monitor, and manage Oracle Linux KVM environments with enterprise-grade performance. The latest versions of Oracle Enterprise Manager (OEM) supports registration and monitoring of Oracle Linux Virtualization Manager. Oracle Enterprise Manager enable entire Oracle stacks from soup to nut to be managed from a single pane of glass.

Oracle Clusterware

Oracle Clusterware is software that enables servers to operate together as if they are one server. Each server looks like any standalone server. However, each server has additional processes that communicate with each other making the separate servers appear as if they are one server to applications and end users. Oracle Clusterware makes it easy to scale applications, increase performance, reduce total cost of ownership (TCO), while providing high availability (HA), reduced unplanned and planned downtime. It's also a requirement for using Oracle Database Real Application Clusters (RAC).

Oracle DTrace.

DTrace is KVM unique and an Oracle contribution to the code. It is not available on VMware vSphere. Oracle Linux DTrace is a comprehensive, advanced tracing tool for troubleshooting systematic problems in real time, providing a single view of the software stack, from kernel to application. This provides rapid identification of performance bottlenecks and greatly simplifies troubleshooting. Simpler, faster troubleshooting, and performance tuning saves time while greatly increasing productivity.

Straightforward Oracle Linux KVM Support Pricing

Oracle's pricing for support is simple and flexible unlike VMware vSphere or other KVM distributions. Support pricing is calculated on a per-system basis and customers can choose one of two levels of support on each server in their deployment.

Oracle Support Comparison

	Premier	Basic
24x7 telephone & online support	√	√
Oracle Enterprise Manager for Linux Mgmt	√	√
Spacewalk support	√	√
HA with Oracle Clusterware	√	√
Comprehensive tracing w/Dtrace	√	√
Oracle Linux load balancer	√	√
Comprehensive indemnification	√	√
Oracle container runtime for Docker	√	√
Oracle Linux Virtualization Manager	√	X
Zero-downtime patching w/Ksplice	√	X
Oracle Linux Cloud Native Environment	√	X
Include Kubernetes, Kata Containers, & more	√	X
GlusterFS Storage for Oracle Linux	√	X
Oracle Linux SW collections	√	X
HA services support (Corosync & Pacemaker)	√	X
Premier backports	√	X
Lifetime sustaining support	√	X

Yeah, But What About VMware vSphere Advanced Features?

There are several commonly used vSphere advanced features such as vMotion, Storage vMotion, SRM, VADP/CBT, HA, vCenter, etc. Oracle Linux KVM has equivalents as seen in the table below. There are differences. However, most are process differences.

Feature	Oracle Linux KVM	VMware vSphere
Mgmt Console	OLVM	vCenter Director
Troubleshooting	Dtrace	vCenter Director
VM Migration	Live Migration	vMotion
Storage Migration	Live Storage Migration	Storage vMotion
HA	Yes - Oracle Clusterware - same tech as Oracle RAC	Yes
Resource Mgmt	Cluster scheduler & policies, affinity	DRS
Security	sVirt, SELinux, firewall, & Ksplice	ESXi Firewall, vShield Endpoint
Live Snapshots	Yes	Yes
Backup SW Integration	Ltd via BU & recovery API	VADP & CBT
Native DR	Requires storage vendor integration w/SRM	Requires storage vendor integration w/REST API
Automation & Orchestraion	Ansible® Engine integration included	vRealize
Role-based access control (RBAC), Active Directory (AD) integration, tiered access	Yes	Yes
Over-Commit	Memory ballooning	Memory ballooning
API & SDK	REST API/ Python command line (CLI), Hooks, Java SDK, Python SDK	Web services API/ SDK, common information model (CIM), Perl, .NET, JavaTM SDKs
Networking	VLAN tagging, QoS, Bonding, Jumbo Frames, IPv6, virtual network interface controller (vNIC) profiles	Virtual LAN (VLAN) tagging, quality of service (QoS), Bonding, Jumbo Frames
Container support	Open Source Docker & Kubernetes	Photon & vSphere Integrated Containers
SW Defined Networking	Open Source OpenFlow, Open vSwitch & KVM SDN Lab Installation App	NSX
SW Defined Storage	GlusterFS & 3rd party ISVs	vSAN
Hot add virtual devices	Disk, vCPU, memory, NIC	Disk, vCPU, memory, NIC

Conclusion

KVM is winning over VMware vSphere because it has significant advantages. Advantages that include being open source, noticeably better performance, better scalability, significantly better hardware resource utilization, much lower licensing and support costs, and even lower TCO. Oracle Linux KVM has even lower

costs because of capabilities such as hard partitioning, Ksplice, native bi-direction cloud migration, accelerated application deployments, Clusterware, DTrace, simple and flexible support pricing.

VMware vSphere is a legacy hypervisor solution with a very large install base. It is not a superior product in any way that matters. IT organizations that have not evaluated KVM and more specifically Oracle Linux KVM, are doing a great disservice to their organization and their budgets.

For More Information on Oracle Linux KVM

Datasheet: Oracle Linux KVM