

LOKI – Linux OpenStack Kubernetes Infrastructure

Tech Sheet

OpenInfra

The Open Infrastructure Foundation (OpenInfra) is the expansion of the OpenStack Foundation to reflect the evolution of cloud infrastructure, especially now that containers are the deployment vehicle of choice. LOKI is an OpenInfra project that includes the most popular open-source platforms for providing cloud services: Linux, OpenStack, and Kubernetes.

Linux

Kernel-based Virtual Machine (KVM) is the hypervisor module included in the mainline Linux kernel. QEMU (short for Quick EMULATOR) is the user-space component. The QEMU-KVM combination (often just called KVM) allows Linux to support virtual machines (VMs). KVM does not emulate many devices so most of the hardware emulation takes place in QEMU. QEMU calls KVM to access acceleration features in the Linux kernel.

OpenStack

OpenStack is the open-source platform for operating cloud infrastructure and is used to offer IaaS, i.e., VMs, bare metal servers, and other resources, provided with utility billing. Large enterprises (e.g., Workday and Walmart) and public cloud providers (e.g., Rackspace) use OpenStack tools to run their own AWS-like clouds. OpenStack is popular among telcos (e.g., AT&T, Verizon, and China Mobile).

Kubernetes

Kubernetes is the open-source container-orchestration platform for automating deployment and management of containerized applications at large scale.

Market Position

Started by NASA and Rackspace in 2010, OpenStack has been viewed historically as an open-source alternative to AWS but was not able to keep up with the pace of AWS innovation. After pivoting to Network Function Virtualization Infrastructure (NFVI) and the telco market, OpenStack was able to gain momentum. Today, OpenStack is in the top three of most active open-source projects, together with the Linux kernel and the Chromium web browser. More than 25 million OpenStack cores are running in production worldwide. 451 Research projects a \$7.7 billion USD OpenStack market by 2023. Most of its growth is happening in Asia (36%), Latin America (27%), Europe (22%), and North America (17%).

Target Market

Target market for LOKI includes large enterprises building private clouds, 5G wireless providers, and “next wave” of cloud service providers (CSPs). That latter are emerging service providers offering vertical-specific or regional cloud services to deliver more customized products than AWS or Azure.

LOKI and Memory Machine

Linux support: Memory Machine runs on RHEL, Centos, Ubuntu, and Debian.

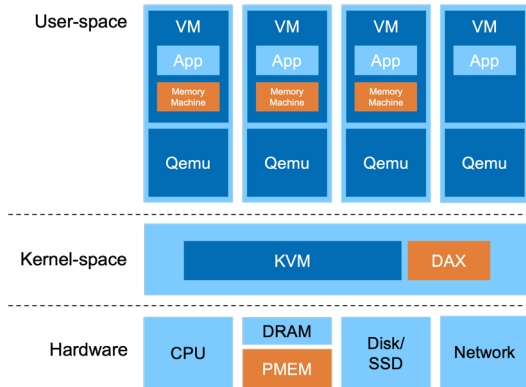
Container support: In a Kubernetes environment, Memory Machine runs in a pod on each container node and manages memory in a local PMem-based persistent volume (PV). A DaemonSet ensures that a Memory Machine pod is always running on the node. The container node can run on a VM (such as KVM) or on bare metal. The Memory Machine

Operator, used to deploy the Memory Machine pod, is certified by Red Hat.

Server virtualization: Memory Machine can be used with KVM in two models, as described below. Memory Machine inside the VM allows granularity: each VM can be configured differently. Memory Machine under the VMs increases the range of applications that can run on Memory Machine (because in this model Memory Machine manages memory at the VM level, not at the individual process level).

Memory Machine Inside VM

Memory Machine can be installed as it would with ESXi, i.e., inside a VM running Linux.



Value Proposition

Memory Machine manages DRAM/PMem efficiently, freeing up DRAM for other VMs or other applications. Memory Machine can be tuned for each application in VM. Not every VM must run Memory Machine or have PMem configured.

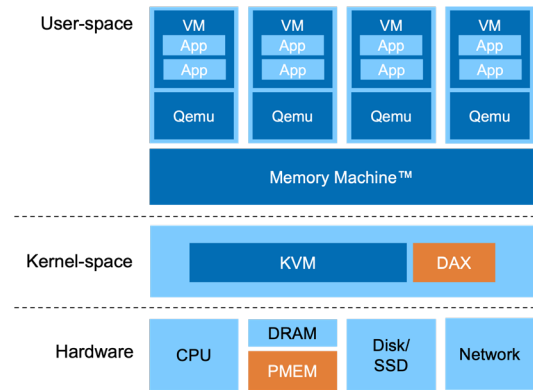
Increasing VM density per server or increasing application density per VM can reduce TCO. Fewer servers translate into easier administration, lower capex, and savings in power, space, and cooling.

More VMs per server translates to more revenue per server, and to improved

profitability for the CSP.

Memory Machine under VM

KVM separates kernel and user space components. Memory Machine can be installed between QEMU and KVM. Memory Machine manages DRAM/PMem for all VMs. VMs cannot distinguish between DRAM and PMem—it’s just memory to the VM.



Value Proposition

Visibility of the entire VM allows Memory Machine to capture an in-memory snapshot of all the processes in the VM. Dynamically managing DRAM capacity at the KVM level allows CSPs to offer new types of VMs, e.g., VMs with “on-demand” DRAM capacity where DRAM capacity is dialed down during peak demand while maintaining performance levels by using PMem. Performance can also be boosted by enhancing current DRAM capacity with additional PMem.

Benchmark Tests

Benchmark tests have been run using popular applications. Redis in the Memory Machine inside VM configuration showed DRAM usage could be reduced by 1/3. MySQL in Memory Machine under VM configuration showed DRAM usage could be reduced by 4x or even 8x (using a DRAM+PMem memory pool). Care should be taken in production environments because other system factors (non-memory related) may influence the overall scaling.