Kernel-based Virtual Machine (KVM)

Sri Lanka

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Campus Systems Linux Essentials

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Virtualization

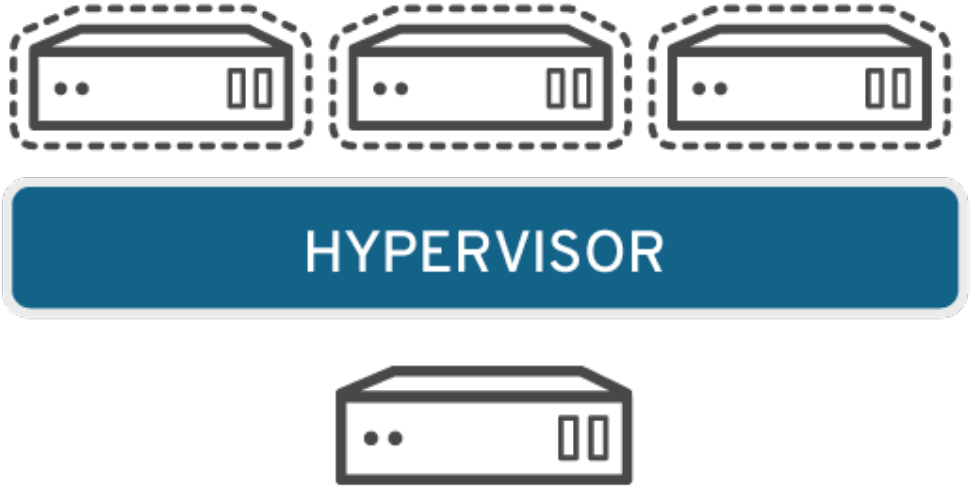
- Abstracting functionality away from the computing (processors, memory, storage and more) resources .
- Allows to use physical computing resources by distributing its capabilities among many users or environments
- Creates an external interface that hides the underlying implementations
- The technology that drives cloud computing economics
- Virtualization enables more efficient utilization of physical computer hardware and allows a greater return on an organization's hardware investment.
- Software called Hypervisors enable virtualization

Types of Virtualization

- Server virtualization
- Desktop virtualization
- Operating system virtualization
- Network virtualization
- Storage virtualization
- Data virtualization
- Application virtualization

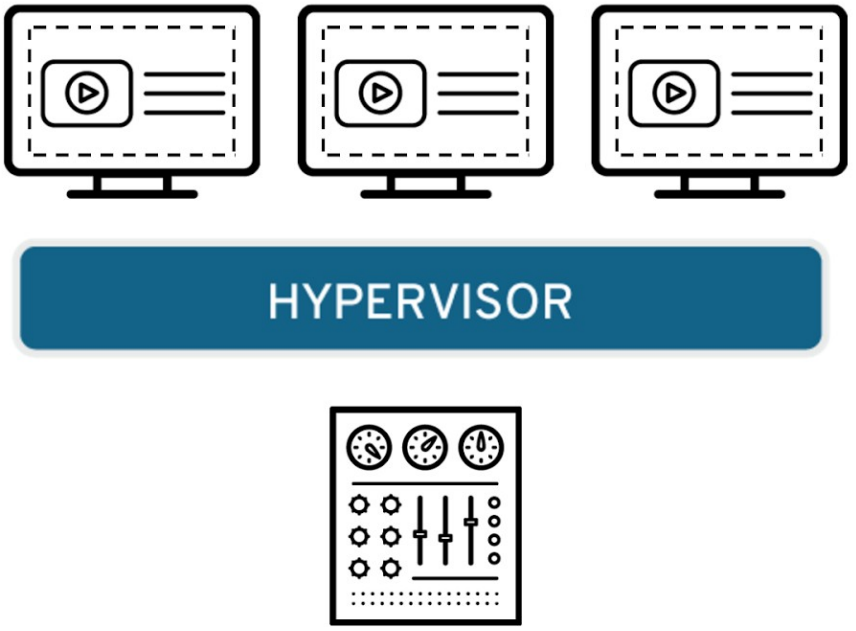
Server Virtualization

- Creates multiple virtual machines from one physical server.
- Virtual machines can be installed an its own operating system.



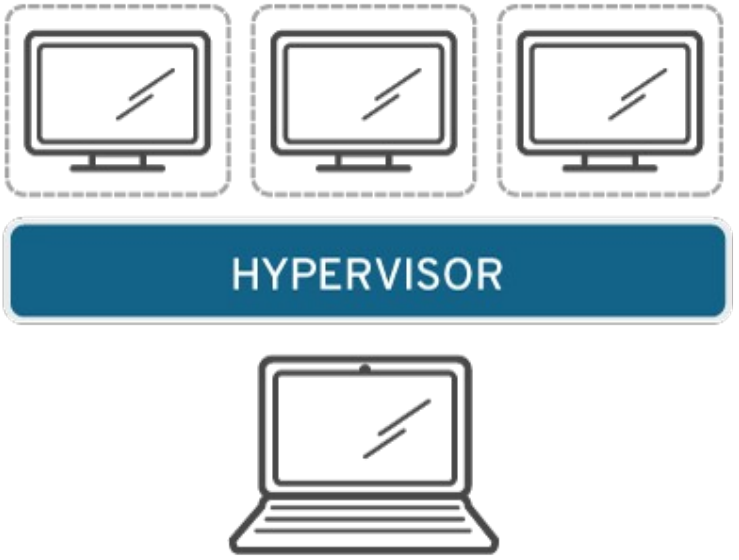
Desktop Virtualization

- Simulated desktop environments on a virtualization platform so that it can be remotely accessed.
- Desktop virtualization allows admins to perform mass configurations, updates, and security checks on all virtual desktops



Operating System Virtualization

- Implemented at the Operating system Kernel.
- Kernel of an OS allows more than one isolated user-space instances
- Ex: Docker/LXC Containers, Jails etc



Hypervisors

- A hypervisor is a software that creates and runs virtual machines (VMs)
- Also called a virtual machine monitor (VMM)
- Treats the resources like CPU, memory, and storage as a pool
- Manages and schedules the resources given to VMs against the physical resources
- Host machine - A computer on which a hypervisor runs virtual machines
- Guest machine – Virtual machine
- Two types - Type 1 hypervisor and Type 2 hypervisor

Type 1 Hypervisor

- Runs on bare-metal (takes the place of the operating system)
- Direct access to the hardware resources
- High performance as there is no middle layer
- Better scalability – support large number of VMs
- Better security
- Most common in virtual server/machine scenarios
- Ex:
  - KVM (converts the linux to a type 1 hypervisor)
  - VMware ESXi
  - Microsoft Hyper-V
  - Citrix ZenServer

Type 2 Hypervisor

- Run as an application on an existing operating system
- Has to access the hardware resource through the OS
- Reduced performance due to underlying OS
- Less scalability than bare-metal hypervisor
- Less secure since depends on the OS security
- Used in Desktop/Laptops etc to run alternate OSs and for testing purposes
- Ex:
  - VirtualBox
  - VMware Workstation
  - Microsoft Virtual PC

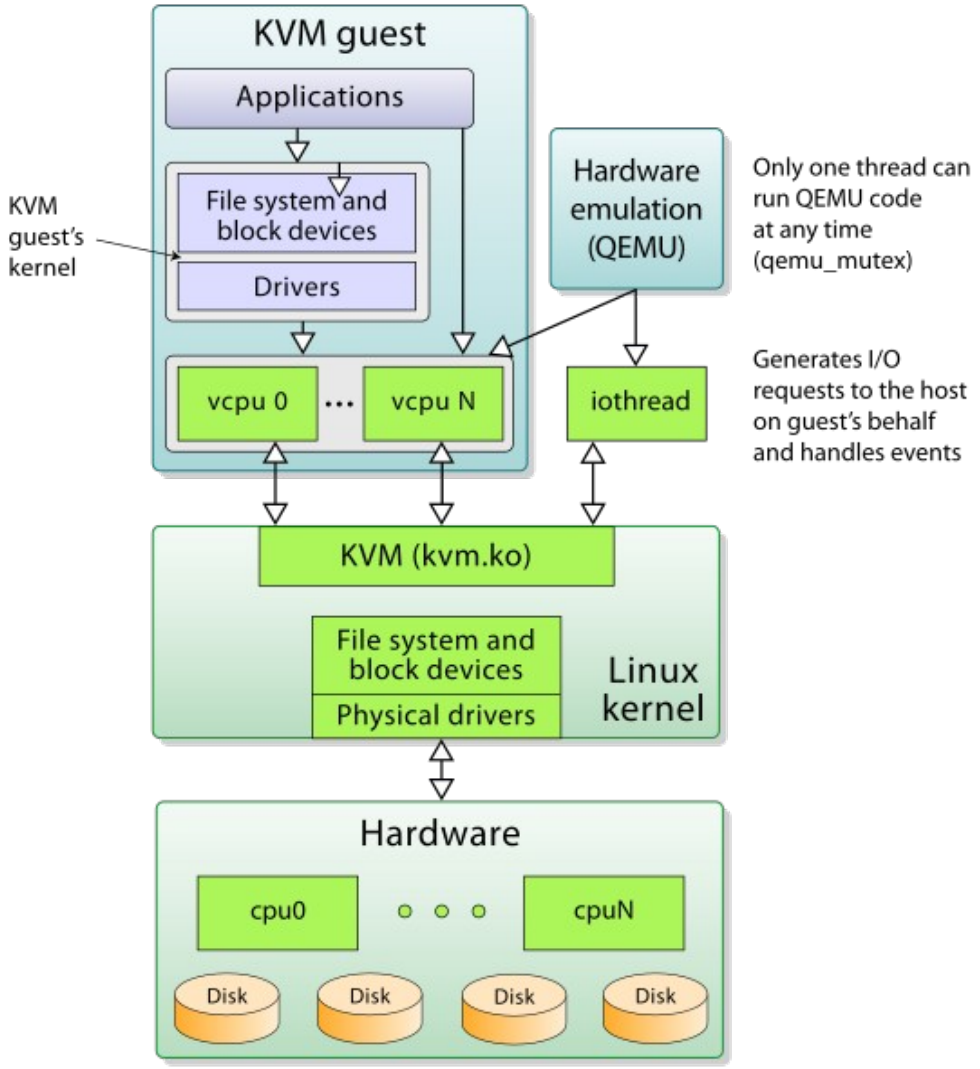
Virtualization benefits

- Virtualization has below benefits and more
  - Improved capacity usage
  - Lower power consumption
  - Reduced system administration overhead
  - Better reliability (uptime, data loss)
  - Heterogeneous hardware platform created through virtualization
  - Not tied to a particular vendor - Migrations are easy
  - Reduced physical space
  - Reduced shipping costs
  - Reduced logistics
  - For testing and education

KVM

- A Virtualization module in the Linux Kernel.
- Full virtualization solution for Linux on x86 hardware
- KVM converts Linux into a type-1 (bare-metal) hypervisor
- Can run multiple virtual machines running Linux or Windows
- Inherits performance of Linux
- Supports 32 and 64 bit (on 64 bit hosts) guests
- Support Snapshots, Live migration (move between two hosts while running)
- Open source and default in Linux

KVM Architecture



QEMU

- User space software which emulates disk, network, VGA, PCI, USB, serial/parallel ports, etc.
- Type 2 hypervisor that runs on operating system
- QEMU uses KVM as accelerator to access the physical CPU virtualization extensions
- Supports the emulation of various architectures including x86, MIPS64, ARM, SPARC, RISC-V etc

Supported Hardware

- An Intel processor with the Intel VT-x and Intel 64 virtualization extensions for x86-based systems
- An AMD processor with the AMD-V and the AMD64 virtualization extensions.

Supported Guest OS

- Linux
  - CentOS, Fedora, RedHat, Debian/Ubuntu, SUSE, Slackware, Android
- Unix
  - OpenBSD, FreeBSD, Solaris, Minix
- Windows family
- Above is very few from a long list available at *https://www.linux-kvm.org/page/Guest_Support_Status*

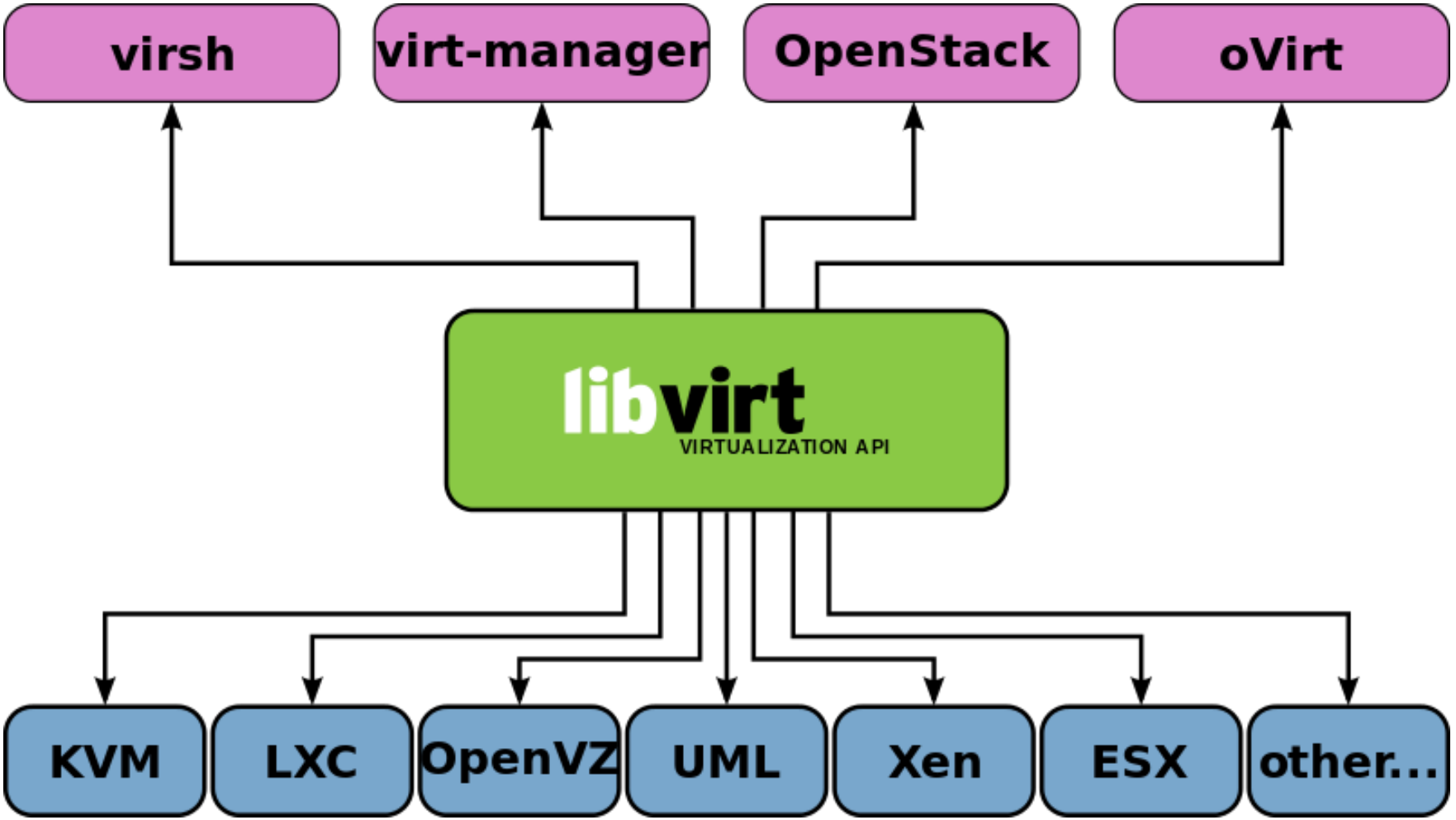
Supported Guest Limits

- Max. Guest RAM size – 512 GB
- Max. Virtual CPUs per guest – 16
- Max. NICs per guest – 8
- Max. Block devices per guest – 4 emulated, 20 para-virtual (using virtio-blk)
- Max. Number of Guest - no more than 8 times the number of CPU cores in the VM Host Server

Libvirt

- A Toolkit to manage hypervisors like KVM, QEMU, Xen, VMWare ESX, LXC and more
- Provides an API to access the virtualization platforms
- API can be accessed with languages C/C++, Python, Perl, PHP, Ruby, Java, Javascript, OCaml (Written in C/C++)
- Used by many applications
  - Command line – virsh, virt-install
  - Continuous integration – Jenkins, BuildBot
  - Desktop – virt-manager, virt-viewer, GNOME Boxes, OpenStack
  - Monitoring – collectd, Nagios-virt

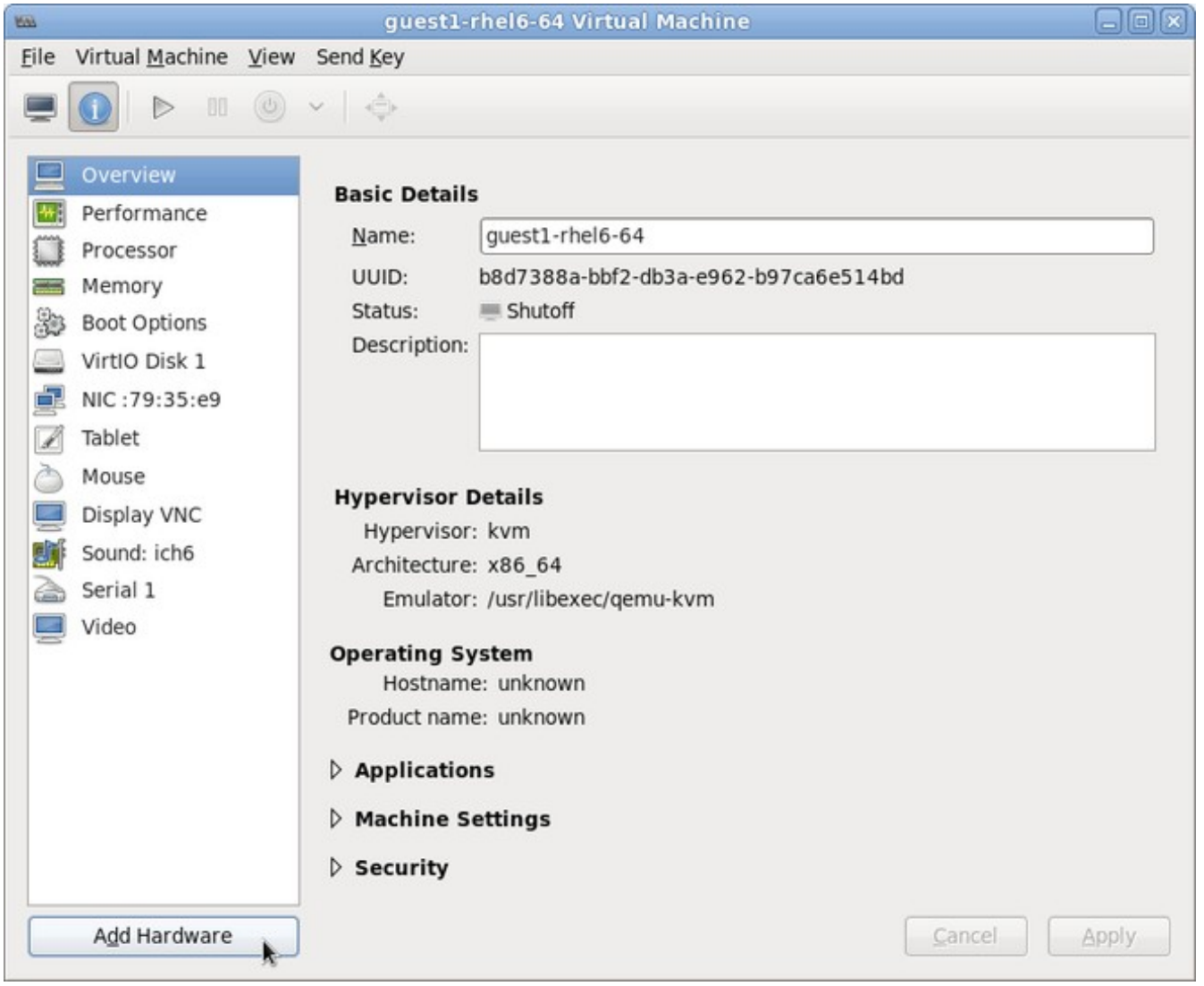
Libvirt


virsh
virt-manager
OpenStack
oVirt
libvirt
VIRTUALIZATION API
KVM
LXC
OpenVZ
UML
Xen
ESX
other...

virt-manager

- Desktop user interface for managing virtual machines through libvirt
- Create, edit, start and stop VMs
- Adjust the hardware resource allocation and virtual hardware
- It primarily targets KVM VMs
  - But also manages Xen and LXC
- It gives summary view of running domains (OS instances), their live performance & resource utilization statistics
- View and control each VM's console through embedded VNC, SPICE clients.

virt-manager



Thank You

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