Operating Systems Virtualization mechanisms

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Contents

Outline

Objectives

Knowledge

- What is virtualization
- Which uses has virtualization
- Which uses does **NOT** have virtualization
- Virtualization solutions

Abilities

- Create/delete virtual machines
- Management capabilities for virtual machines
- Virtual Machine Administration

What is virtualization...

An abstraction mechanism to manage
(by partitioning, by merging,...) physical resources

- Virtualization is based on the creation of one (or more) virtual representations of a particular resource
- Examples
  - Local Area Network (VLAN)
  - Web Virtual Hosts
  - Storage Virtualization (e.g., LVM, Cloud storage)
  - Data Virtualization (e.g., seamless access to information)
  - **Hardware Virtualization**

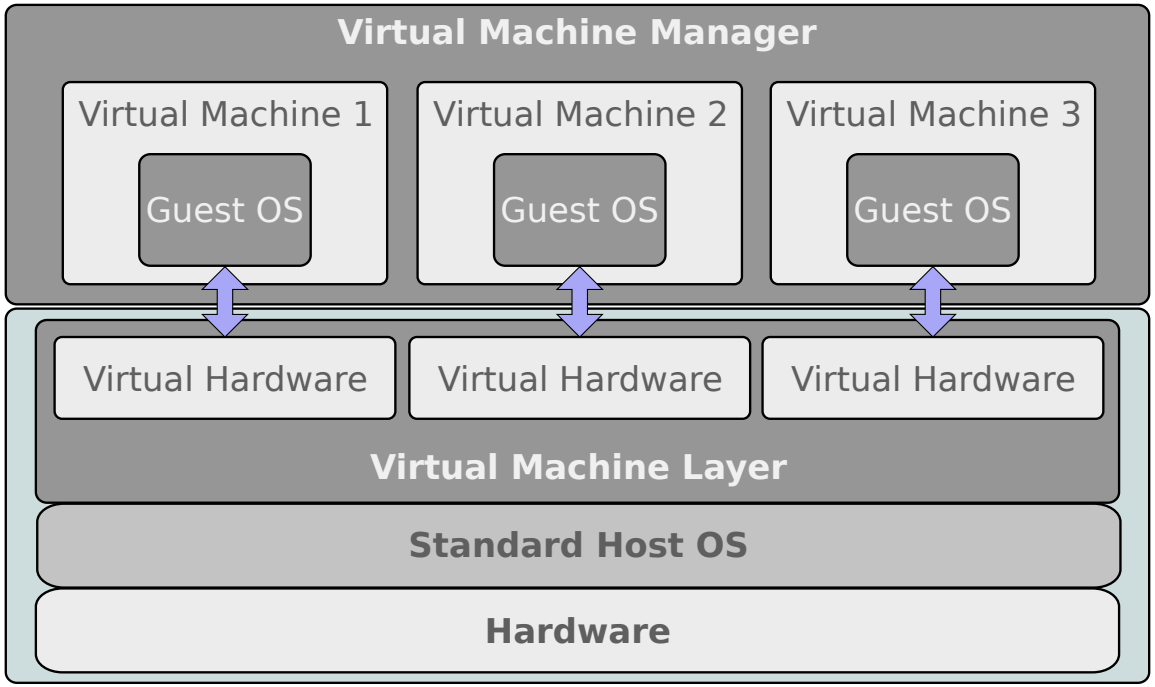
Hardware Virtualization

- The virtualization affects the whole machine where new “virtual” instance is/are created
- The original OS is called *host OS*
- The other “virtual” OS(s) is/are named *guest OS*s
- The new instances work autonomously and use the host OS as proxy with the hardware
- Types of Hardware Virtualization
  - Full Virtualization
  - Paravirtualization
  - Partial virtualization

Outline

Full Virtualization – Overview

- Complete emulation of hardware components
  - Using the legacy OS as proxy to the hardware
- Transparent for guest OS



Full Virtualization – Functionalities and Examples

Functionalities

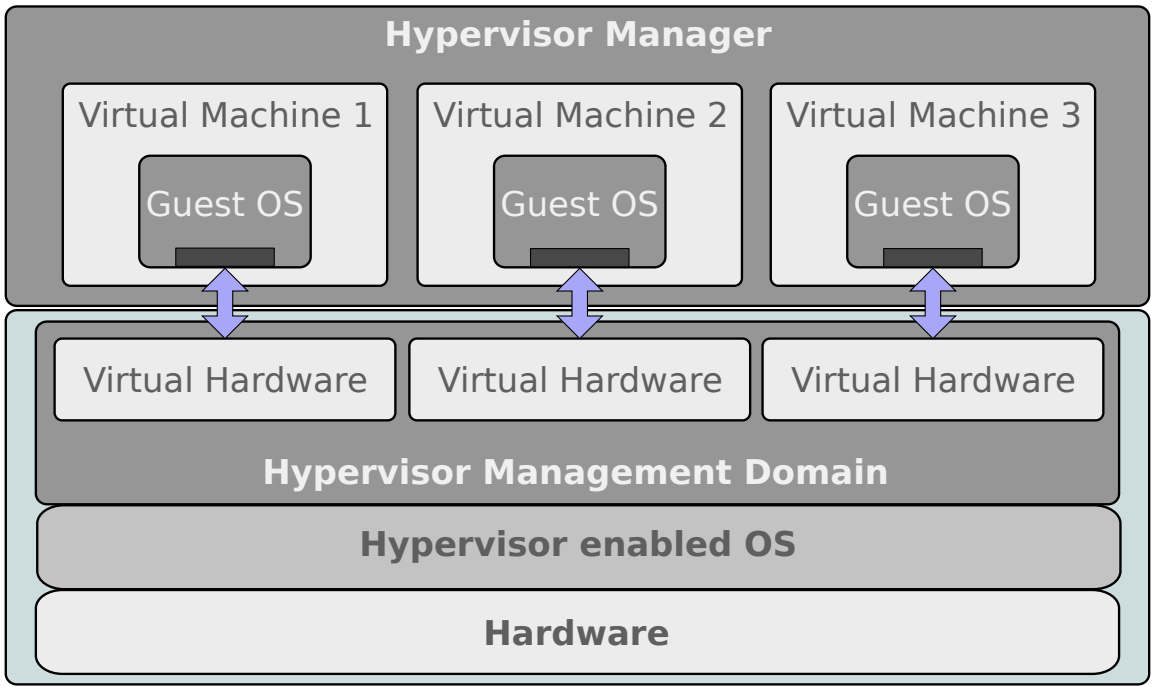
- Memory reservation
- CPU virtualization
- Virtual Network Interfaces

Examples

- Multiplatform
  - VMWare
  - VirtualBox
- Linux
  - QEmu/KVM
- Windows
  - Microsoft® Hyper-V Server 2008
- MacOS
  - Parallels

Paravirtualization

- Concurrent execution of different OS
  - Management Domain controls the rest of OS
- Requires support of the hardware and the OS



Paravirtualization – Functionalities and Examples

Functionalities

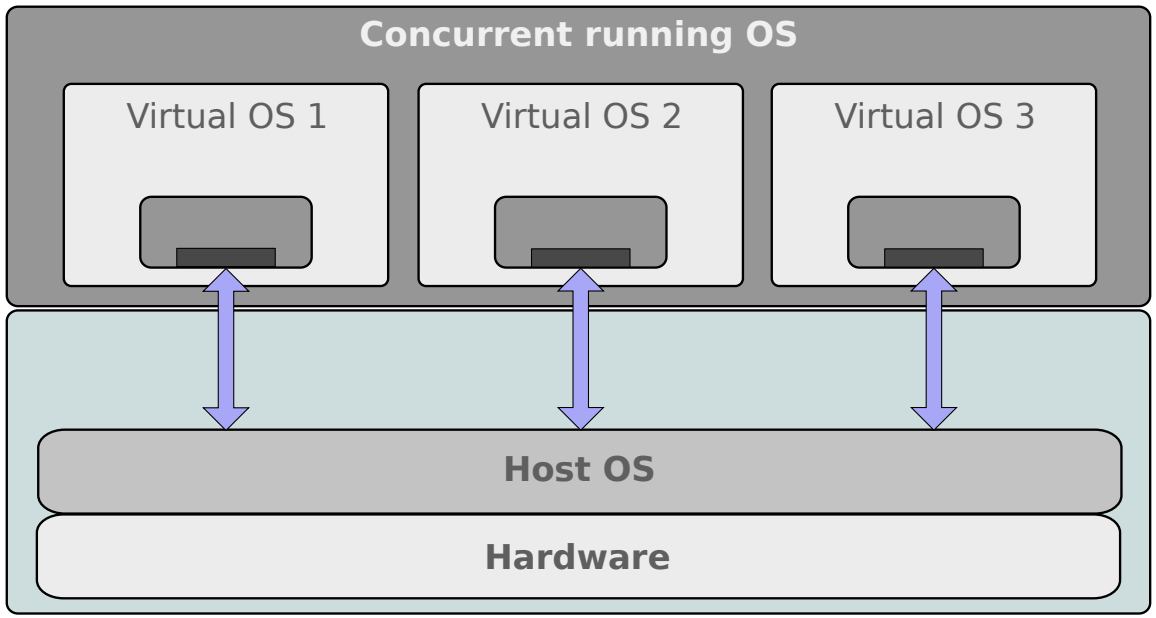
- Memory partitioning
- CPU partitioning
- Network card separation
- Controlled bus access

Examples

- Xen
- UML

OS Virtualization

- Collaboration between host and guests
  - Direct access to the hardware form the guests
  - Can run in userspace
- Requires support of the OS
  - Host and guests use the same OS



OS virtualization – Functionalities and Examples

Functionalities

- Concurrent execution of various instances of the operating system

Examples

- OpenVZ
- Solaris Containers
- BSD Jails
- Linux Containers
  - LXC
  - Docker.io

Outline

Applications

Useful for....

- Energy saving
- Space saving
- Lightweight processes
- Service aggregation

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- Lightweight processes
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Should not be used for...

- Heavyweight processes
- Computational power

Main Functionalities

- Machine level backup/restoration
  - Snapshots
  - Regular backups
- Machine Pause/Suspend
- Service Isolation
- Resource limitation (CPU, Memory, I/O, Networking)
- Machine teleporting
  - Memory teleporting
  - Full machine teleporting
- Cloning
- Centralized management

Outline

Rationale under Cloud Computing

- Offer computation, storage, and services
- Outsourcing of IT local resources through well defined APIs
- Easy adoption for customers
  - Masking operational details
  - Less management overhead
  - Increase in resources
  - Increase in performance
  - Low cost

Delivered services

Software as a Service

- Software licensed on a subscription based fee model
  - Through periodic fees
  - Through advertisement
- Mostly web based
- Examples
  - GMail
  - Facebook
  - Whatsapp

Delivered services

Platform as a Service

- Computing platform
- Customer deploys application using service provider features into the provider's premises
- Provider offers storage, computation, memory, networks, and other necessary facilities
- Examples
  - Amazon Web Services (AWS)
  - Rackspace

Delivered services

Infrastructure as a Service

- Lowest level
- Providing hypervisor, networking, storage
- The customer is in charge of configuring and administering everything
- Examples
  - Amazon Web Services (AWS)
  - Rackspace

Outline

VM Creation

Required steps to create a VM

- Create system hard drive
  - Dynamically allocated – Less space / Slower
  - Statically allocated – More space / Faster
- Create hardware
  - CPU(s)
  - Memory
  - Disk(s)
  - ...
- Install the operating system
- Configure services

VM Deletion

Required steps to delete a VM

- Backup user/shared data
- Disable/ban users
- Stop all the services
- Unregister virtual machine
- Remove the hard drive

VM Resources Management

Resource enhancements

- More CPU(s)
- Memory increase
- Hard disk resizing
  - Different from Filesystem resizing

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System administration

- Use passwordless remote administration (ssh, pssh)
- Create management scripts
  - Send command to all
  - Install to all

Integrated Management Solutions

- libvirt: `virsh`, `virt-manager` http://www.libvirt.org
- VMWare vSphere http://www.vmware.com/products/vsphere
- OpenNebula: http://www.opennebula.org/
- OpenStack: http://www.openstack.org/

Backup mechanisms

Full Hardware backup

- Use available facilities within the Virtualization Software
- Use a master copy of the system

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Full Hardware backup

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Regular backup

- Similar to the legacy case
- Backup shared storage area

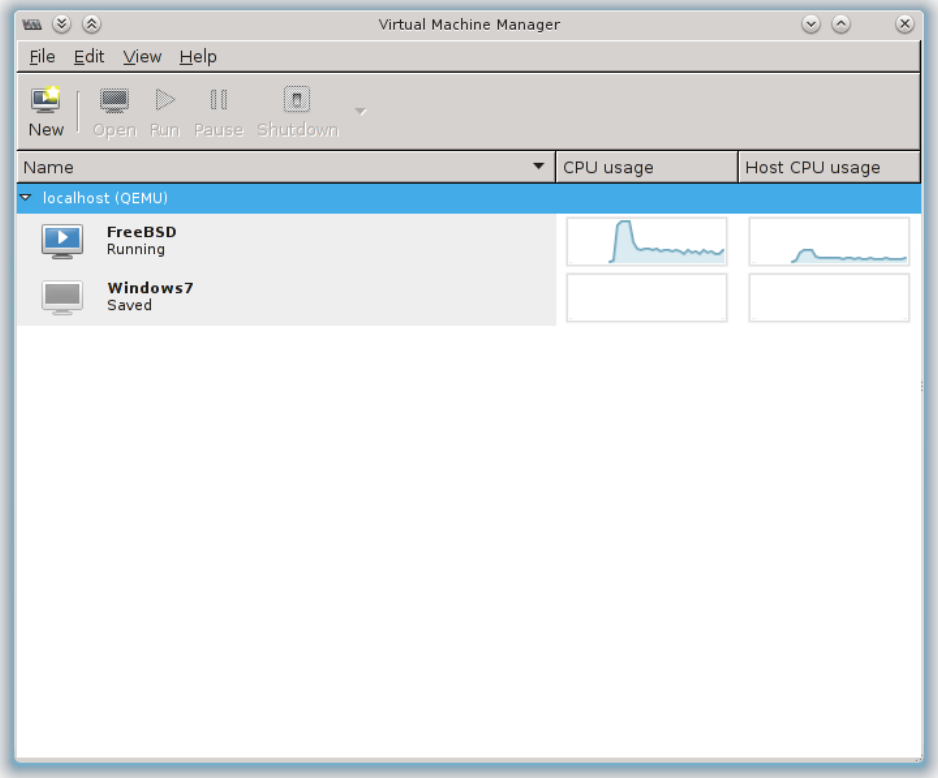
Outline

Practical Tips

- GUI are evil
  - Use headless setups
- Monitor resource usage
- Use shared storage for user data
- Clone the VMs
- Use different servers
  - Resilience
  - Load balancing

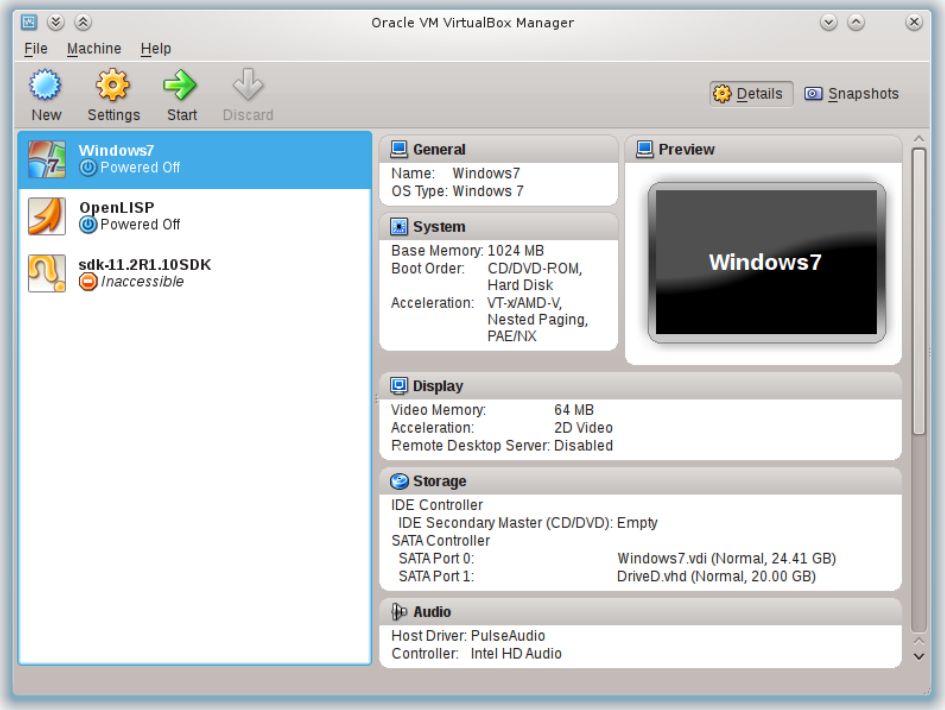
Outline

Management Interface – virt-manager



- Aggregated management and monitoring
- Create/Delete/Modify VMs
- Connect/Disconnect removable media

Management Interface – VirtualBox



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