

**IT 609**

**Network and System  
Administration**

**Virtualization & “The Cloud”**

Tuesday September 30, 2021

# Section Overview

- Quiz #03 Review
- Virtualization
- “The Cloud”
- Assignment #01 - Part 1 - Late (-10%)
- Assignment #02 - Current Event #01 - Due 05-Oct-2021
- Exam #01 - 05-Oct-2021 - on material through 28-Nov-2021

# Virtualization

Virtualization

It's all fake! (and that's good!)

# Virtualization

## Generic definition

“Virtualization is the creation of a virtual (rather than actual) version of something, such as an operating system, a server, a storage device or network resources.” - Whatis.com

## Platform Virtualization

“virtualization of computers or operating systems. It hides the physical characteristics of a computing platform from users, instead showing another abstract computing platform.” - Wikipedia.org

# **Virtualization**

## **In other words...**

**Software**

**running on the real, physical hardware  
creates an virtual (fake) environment  
that looks like and acts like real hardware  
on which other software can run.**

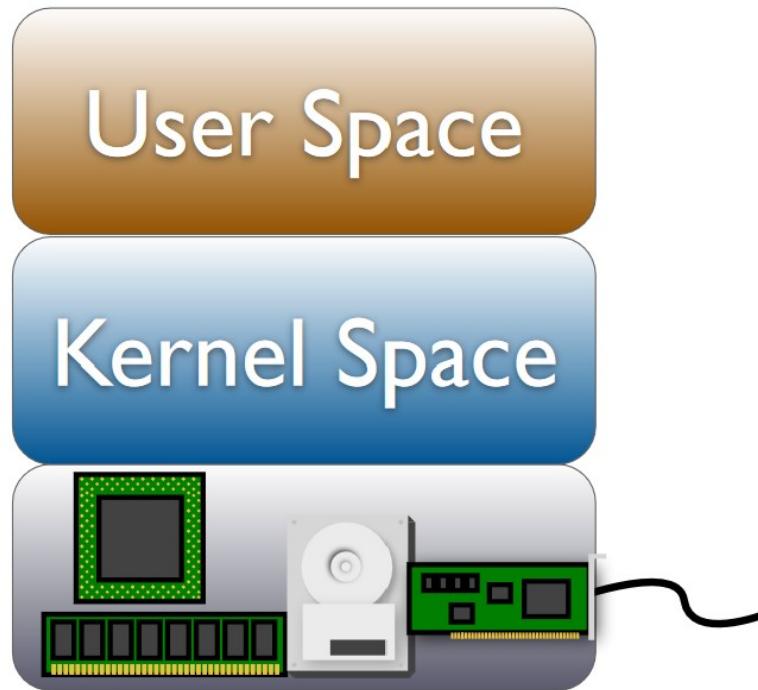
# Virtualization

Sounds complicated....

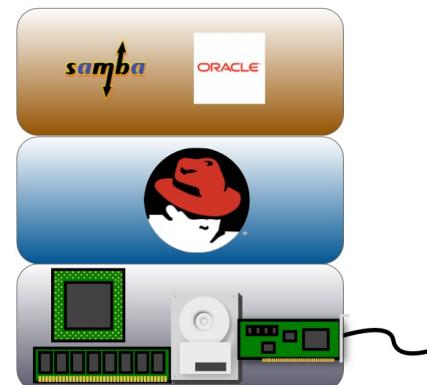
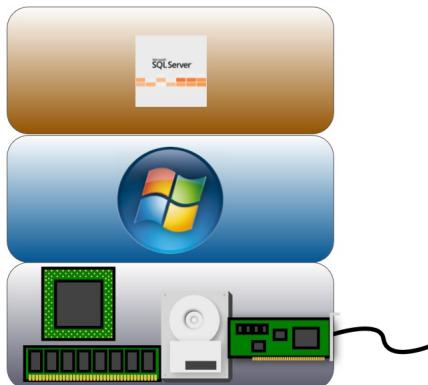
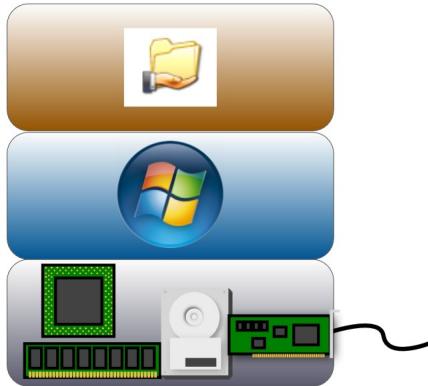
Why would I want to do that??

We'll get there...

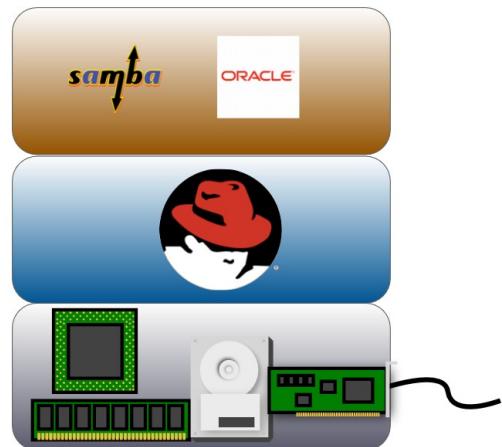
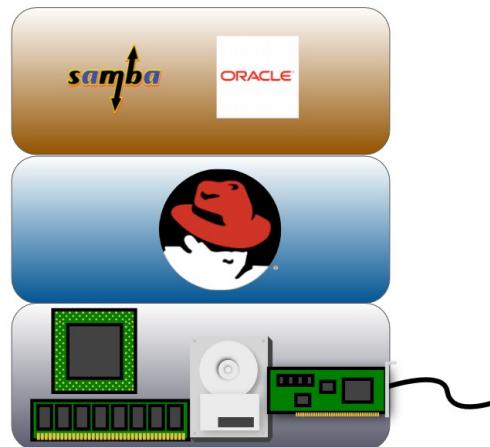
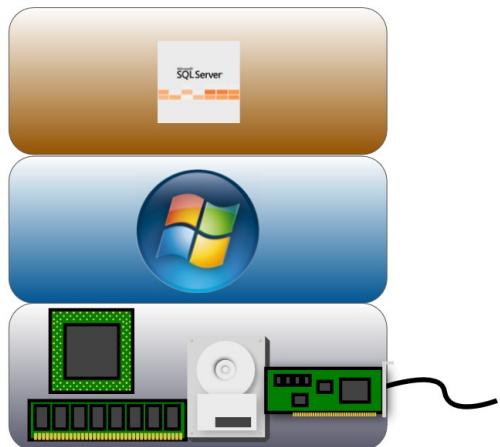
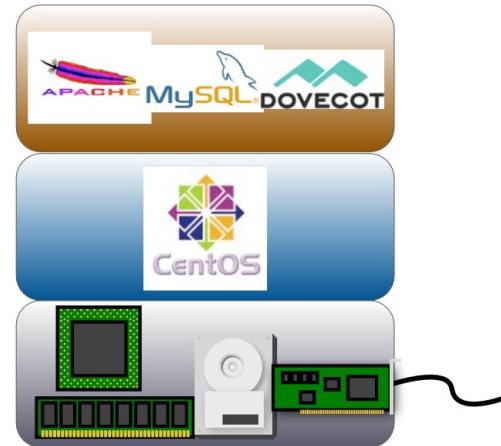
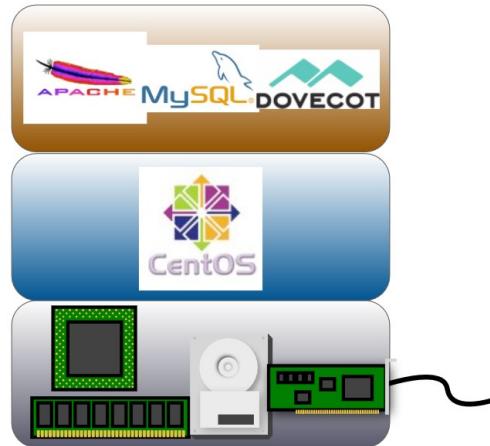
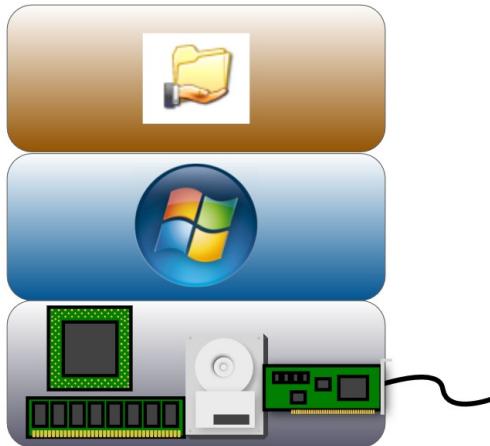
# Virtualization



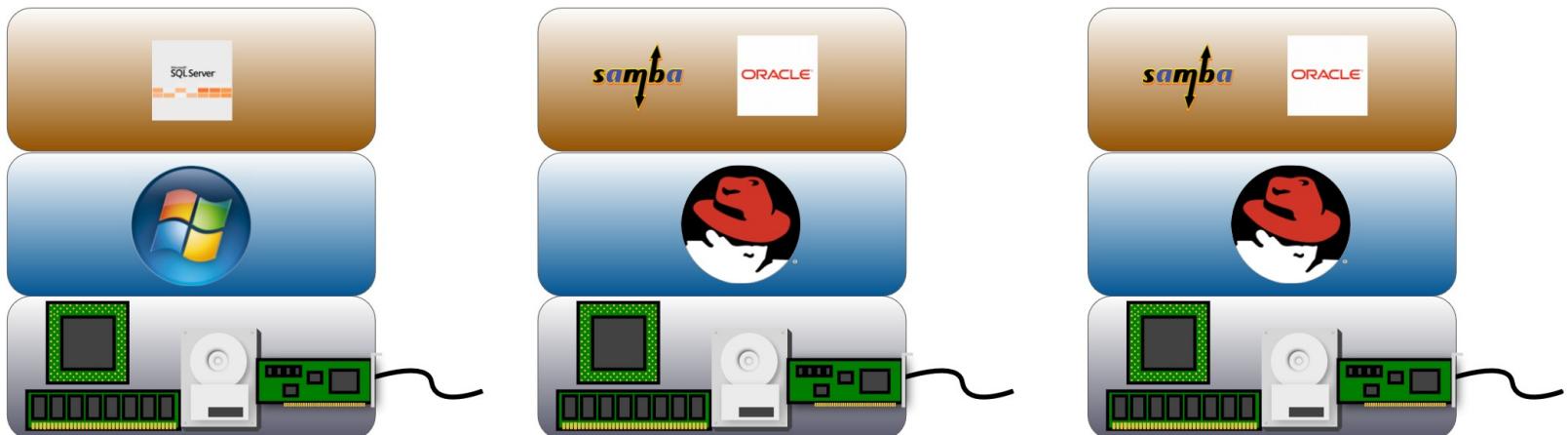
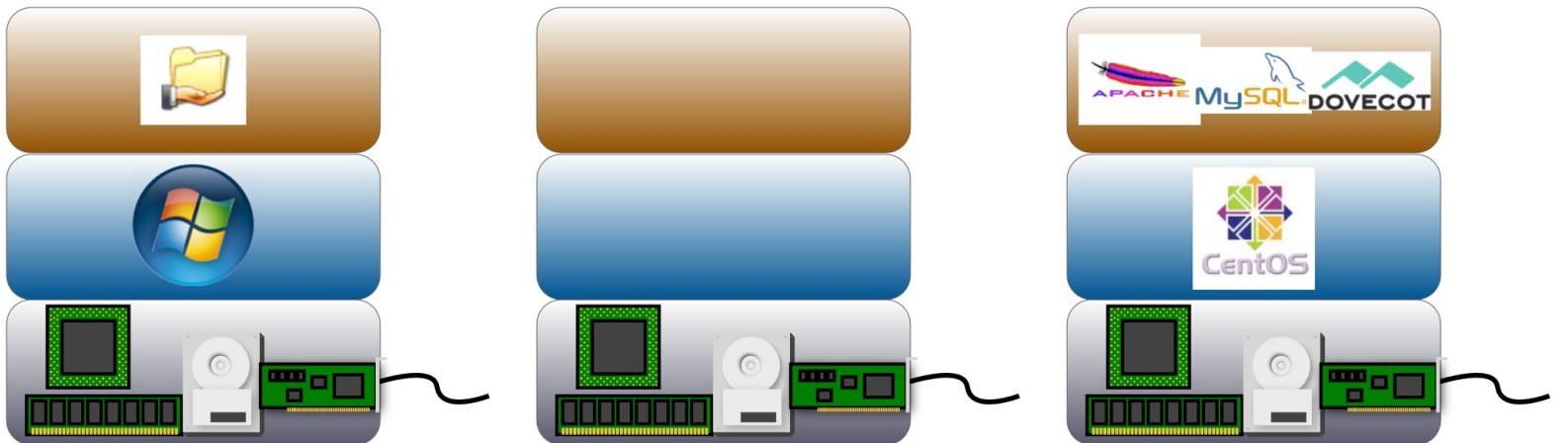
# Virtualization



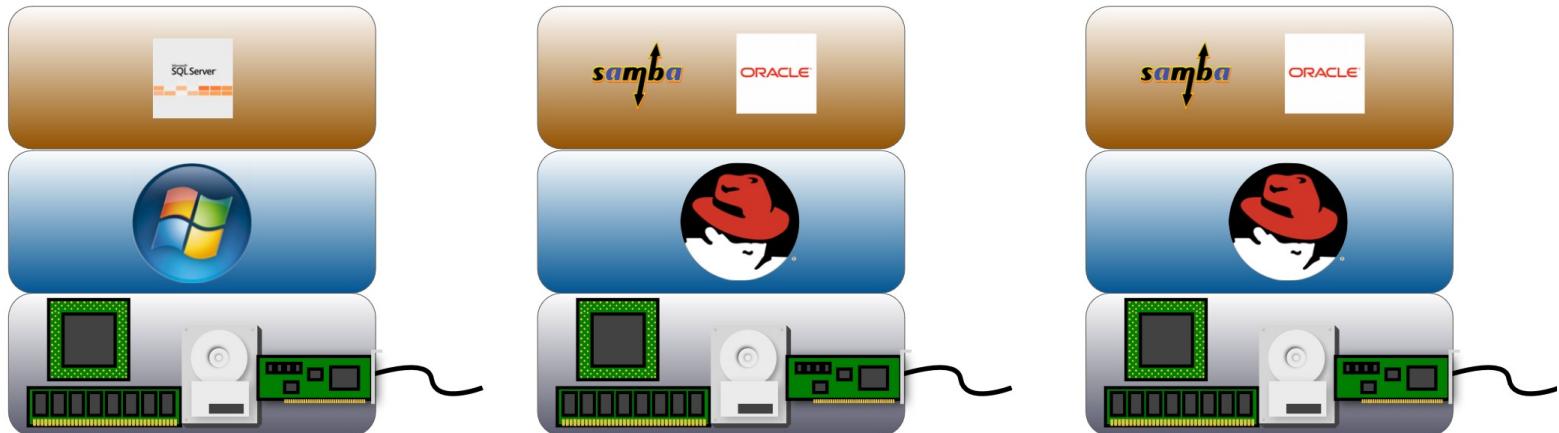
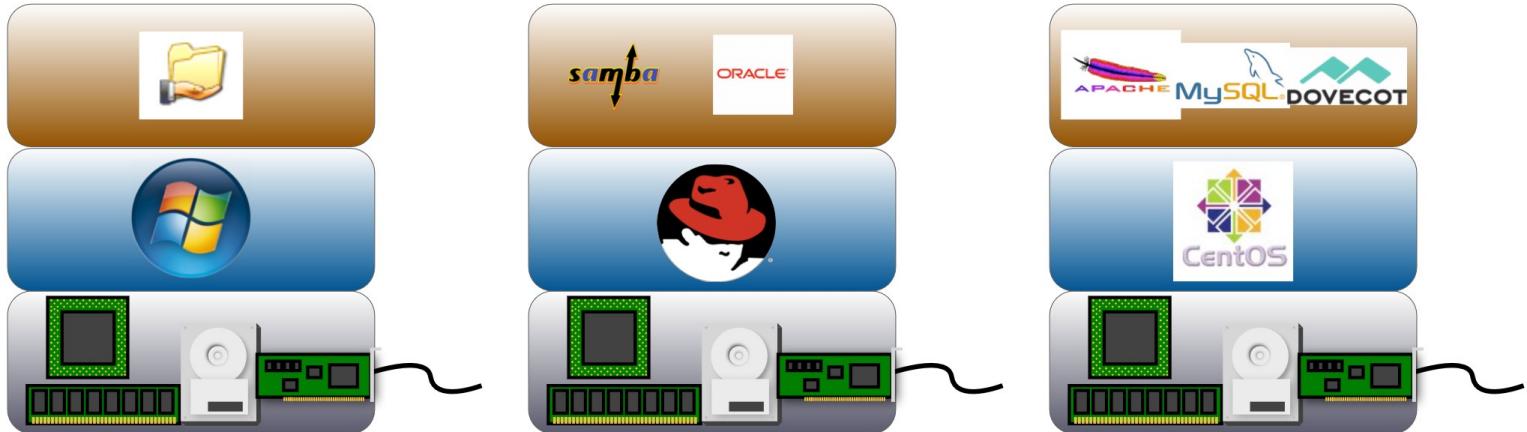
# Virtualization



# Virtualization



# Virtualization



# Traditional Model

A server is:

Dedicated, physical processor

Dedicated, physical memory

Dedicated, physical network interface

Dedicated or shared storage containing filesystems

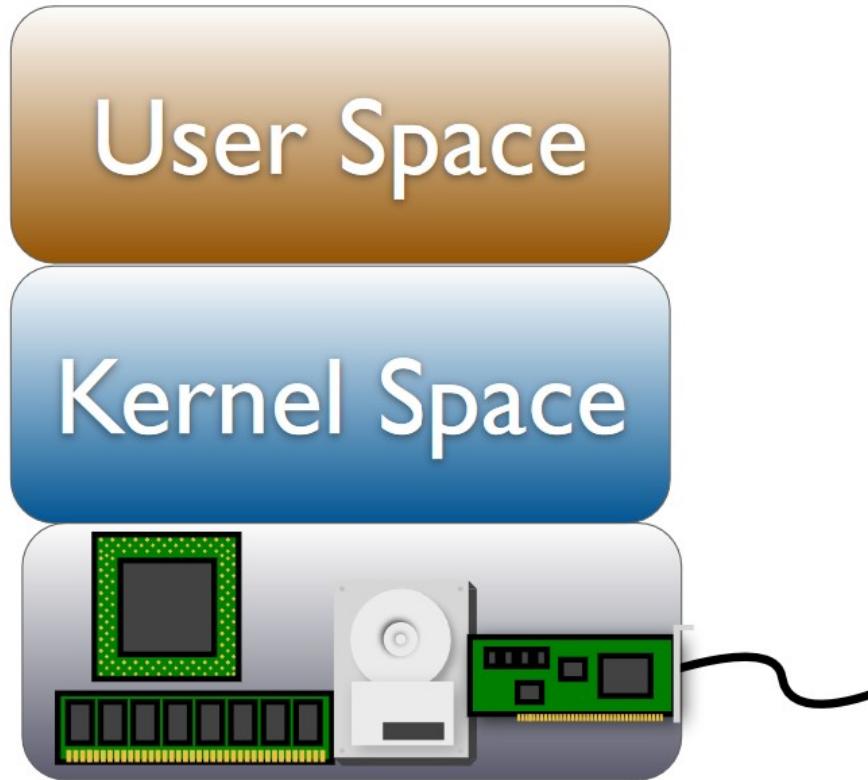
Operating systems on the filesystems

Applications on the filesystems

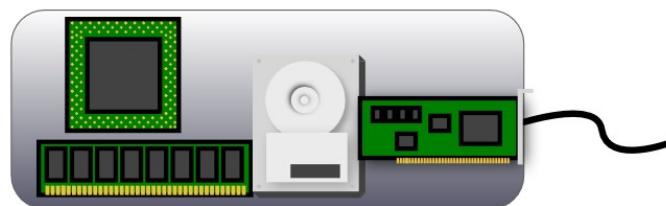
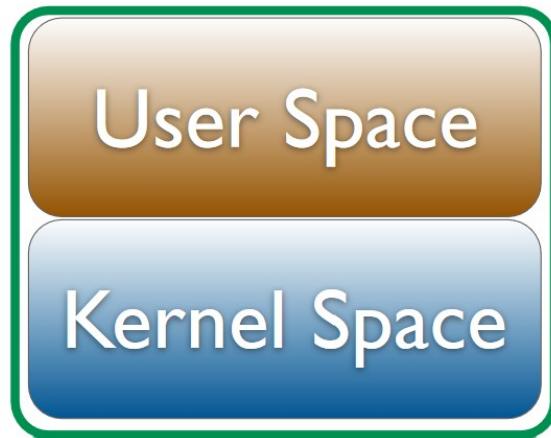
Configuration files on the filesystems

Data files on the filesystems

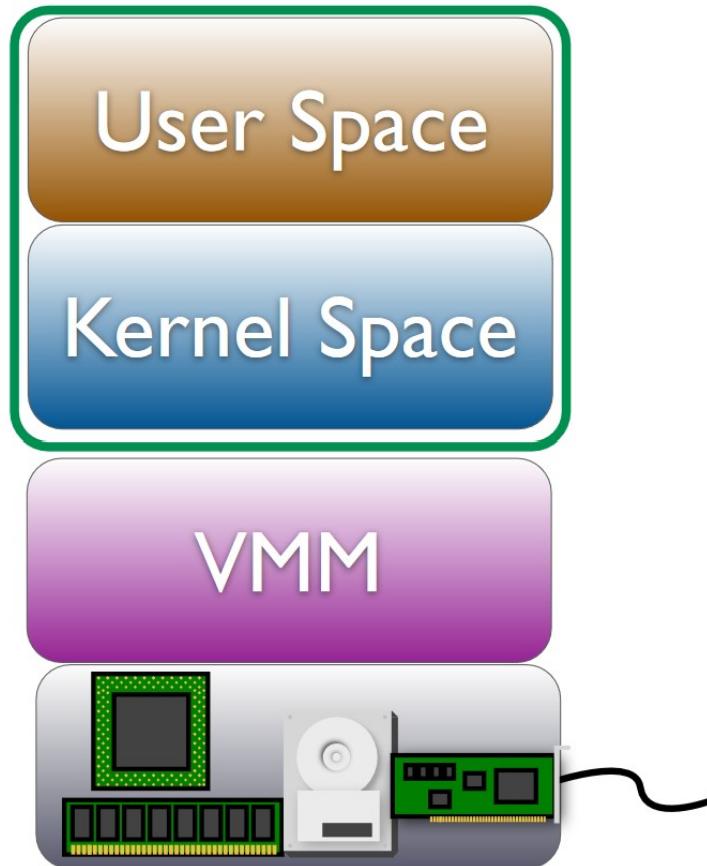
# Traditional Model



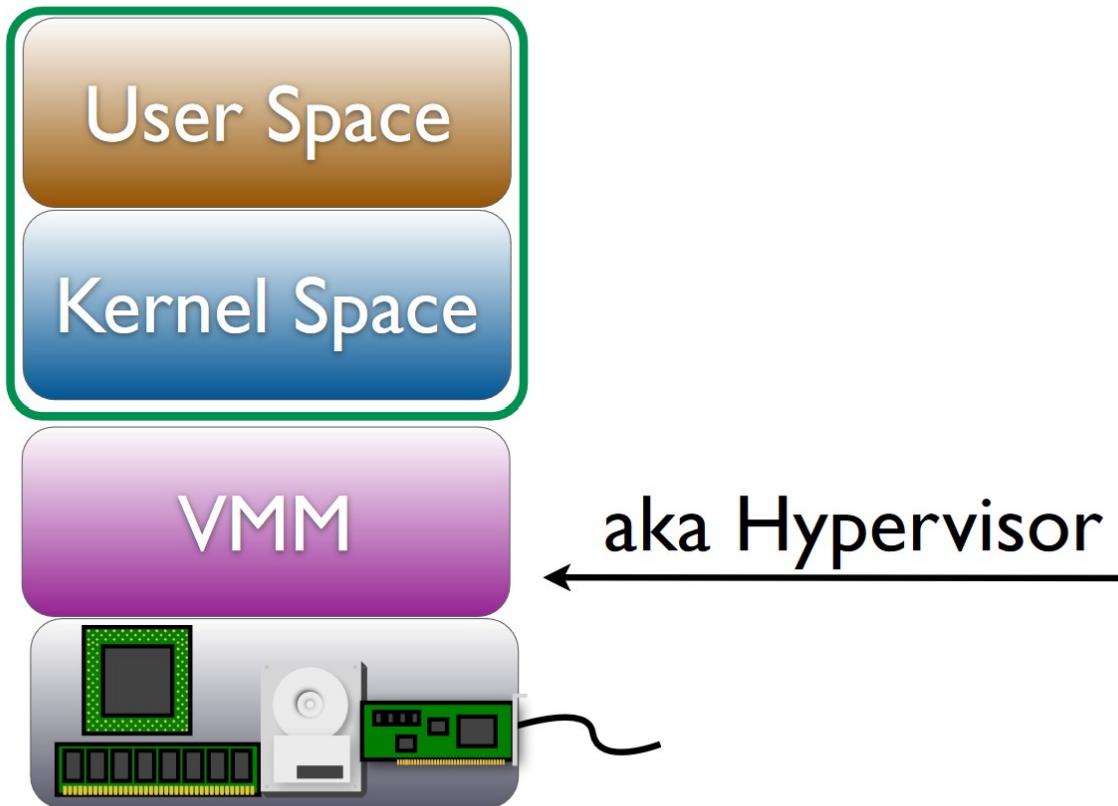
# Traditional Model



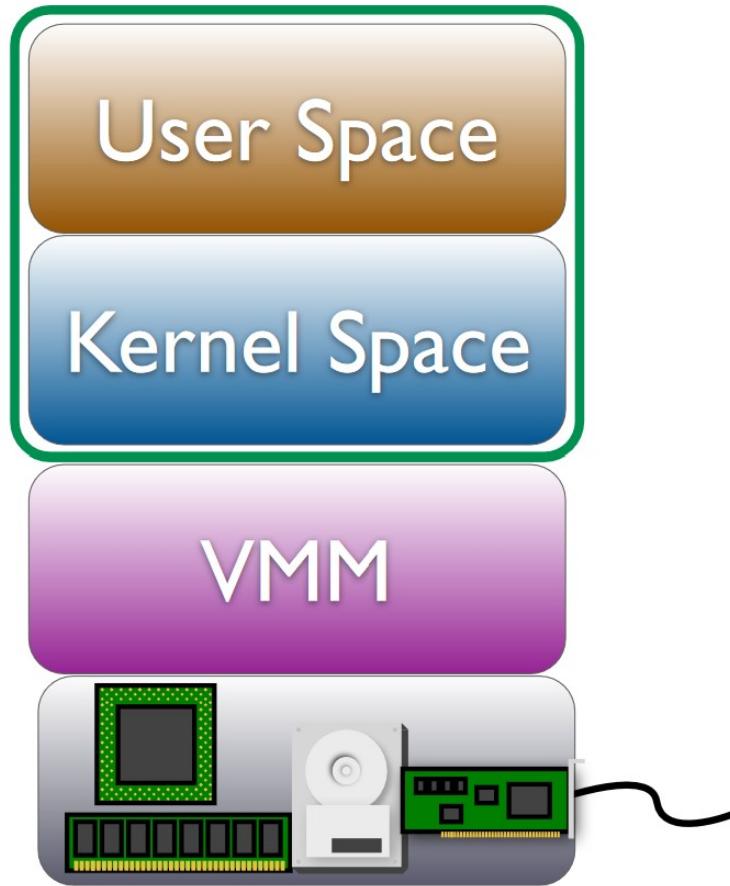
# Traditional Model



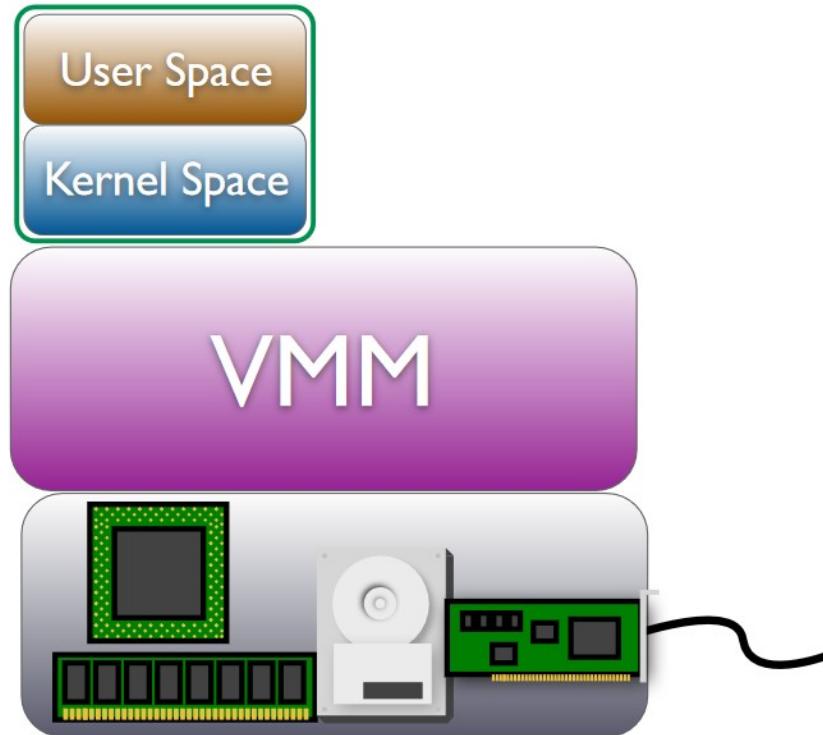
# Hypervisor



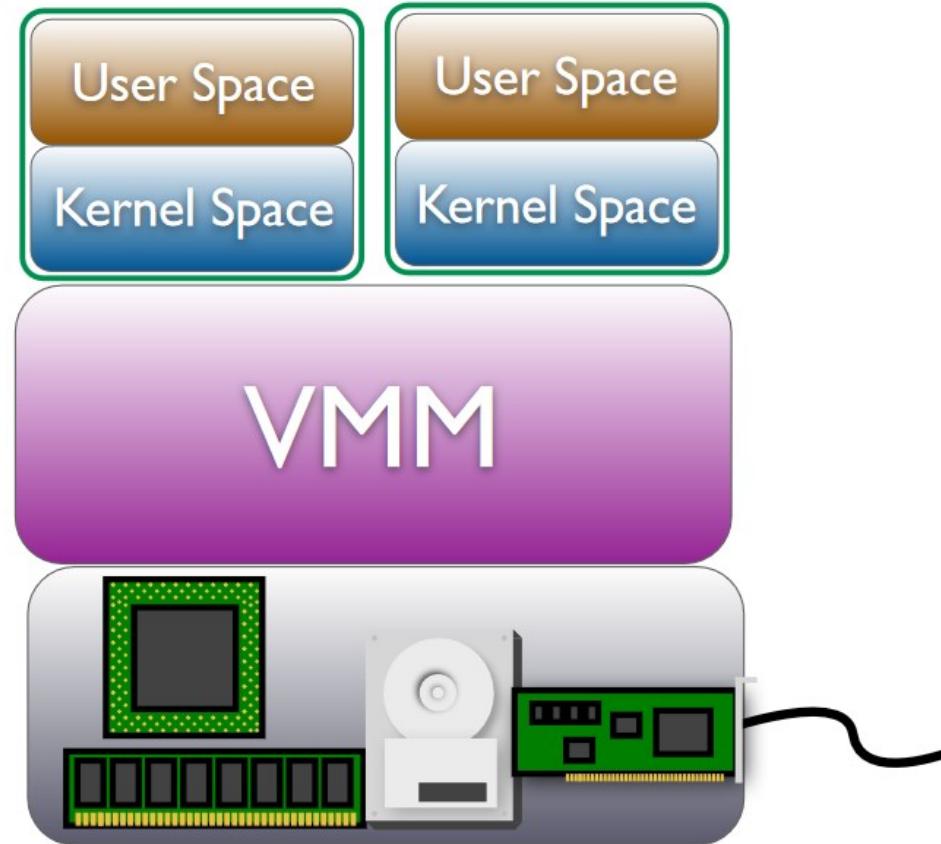
# Hypervisor



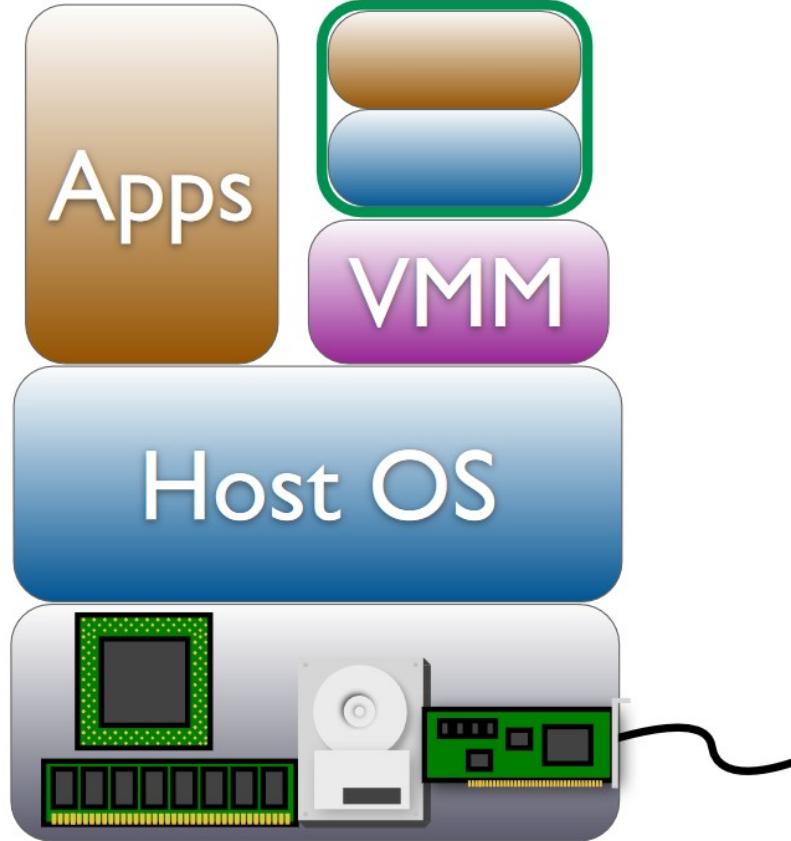
# Hypervisor



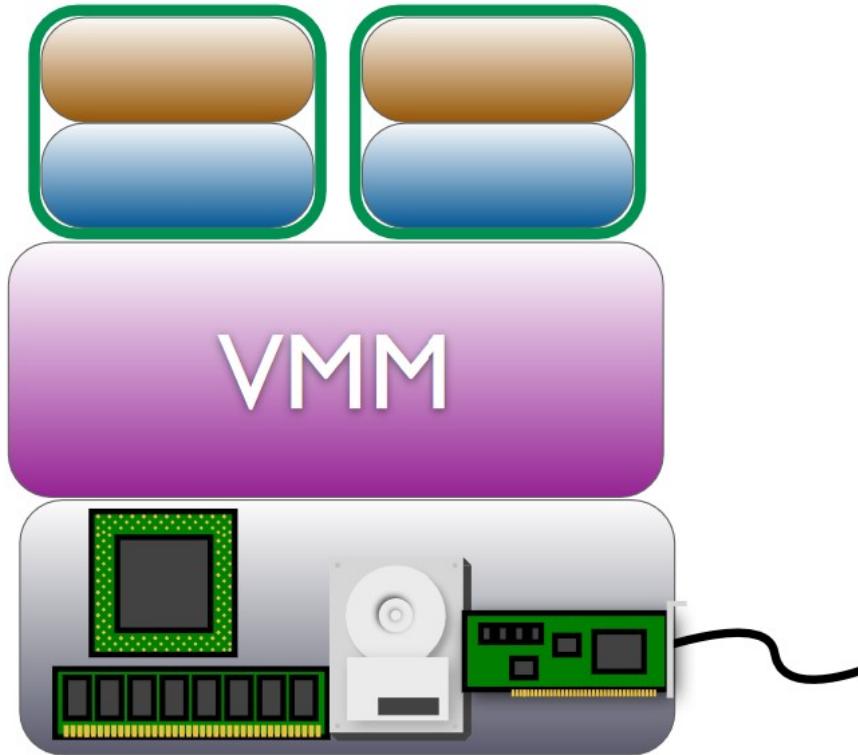
# Hypervisor



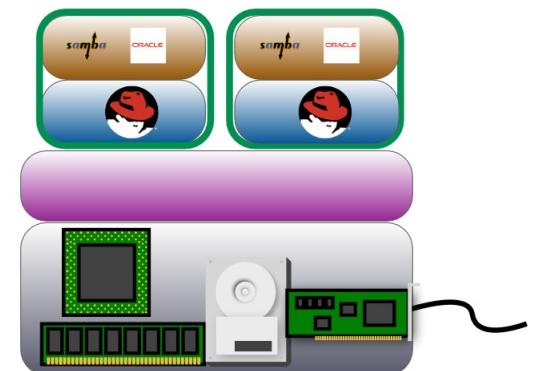
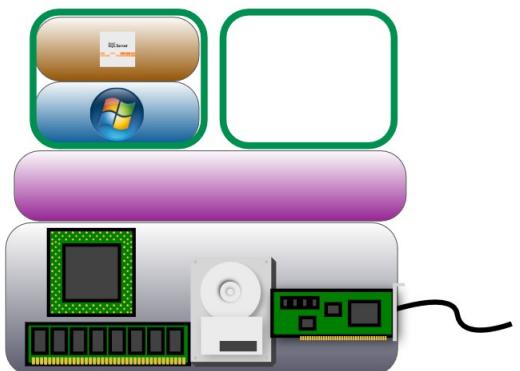
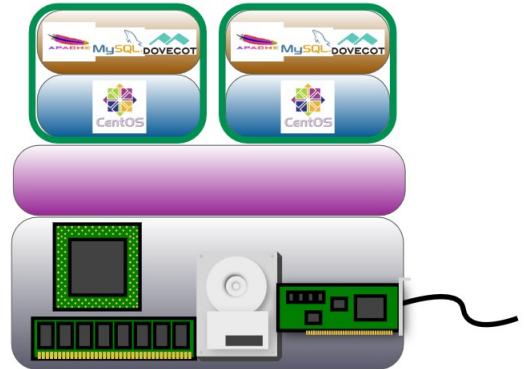
# Virtualization under an OS



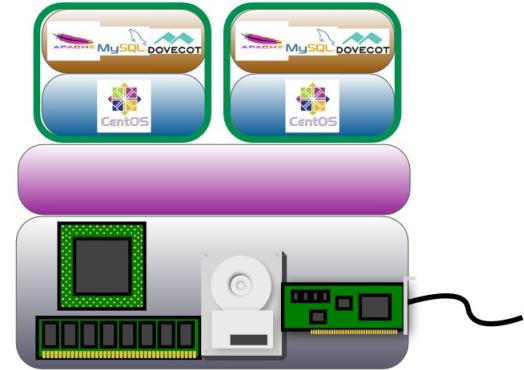
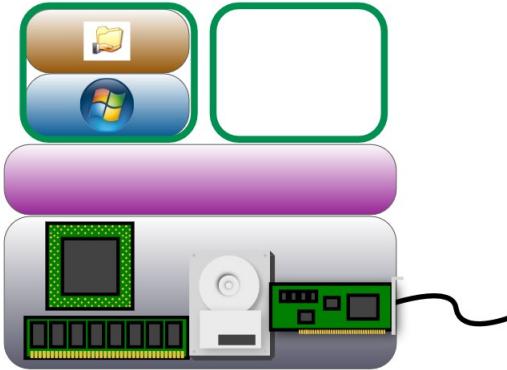
# “Bare-metal” Virtualization



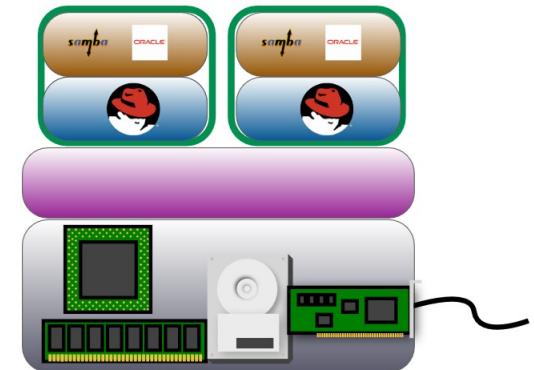
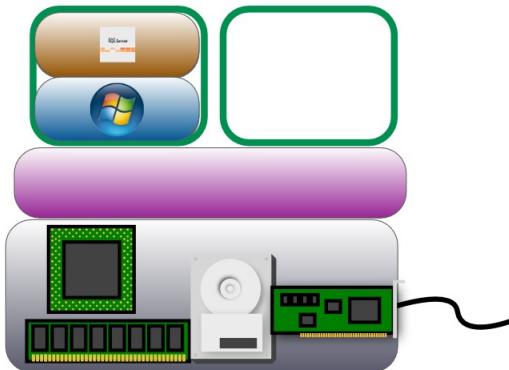
# Virtualization



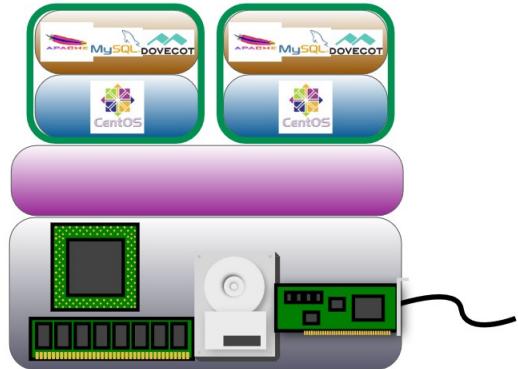
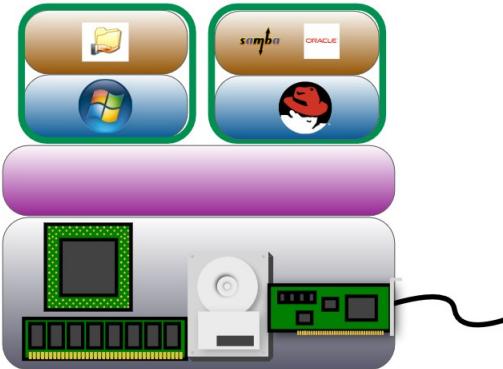
# Virtualization



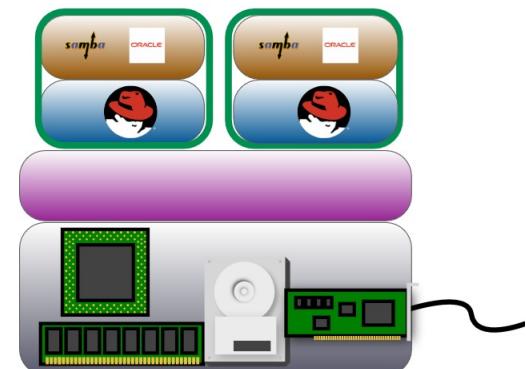
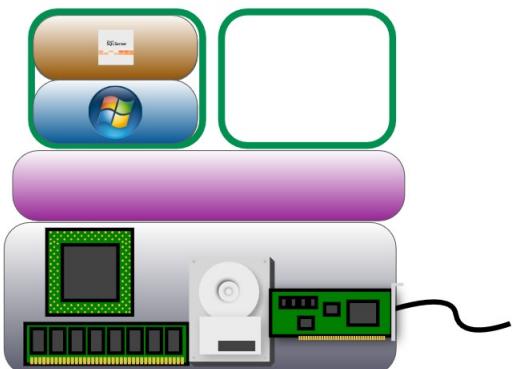
Easy to add more VMs  
- clone & start



# Virtualization



Easy to add more VMs  
- clone & start



# Virtualization



Easy to add more VMs  
- clone & start



# Virtualized

A virtual server is:

A settings file used by the VMM to define how much of the shared resources are used:

- Processors - # and speed

- Memory - how much

- Network interfaces - how many and networks used

- Storage files or devices - how big, where stored

Virtual disk files holding:

- Operating systems

- Applications

- Configuration files

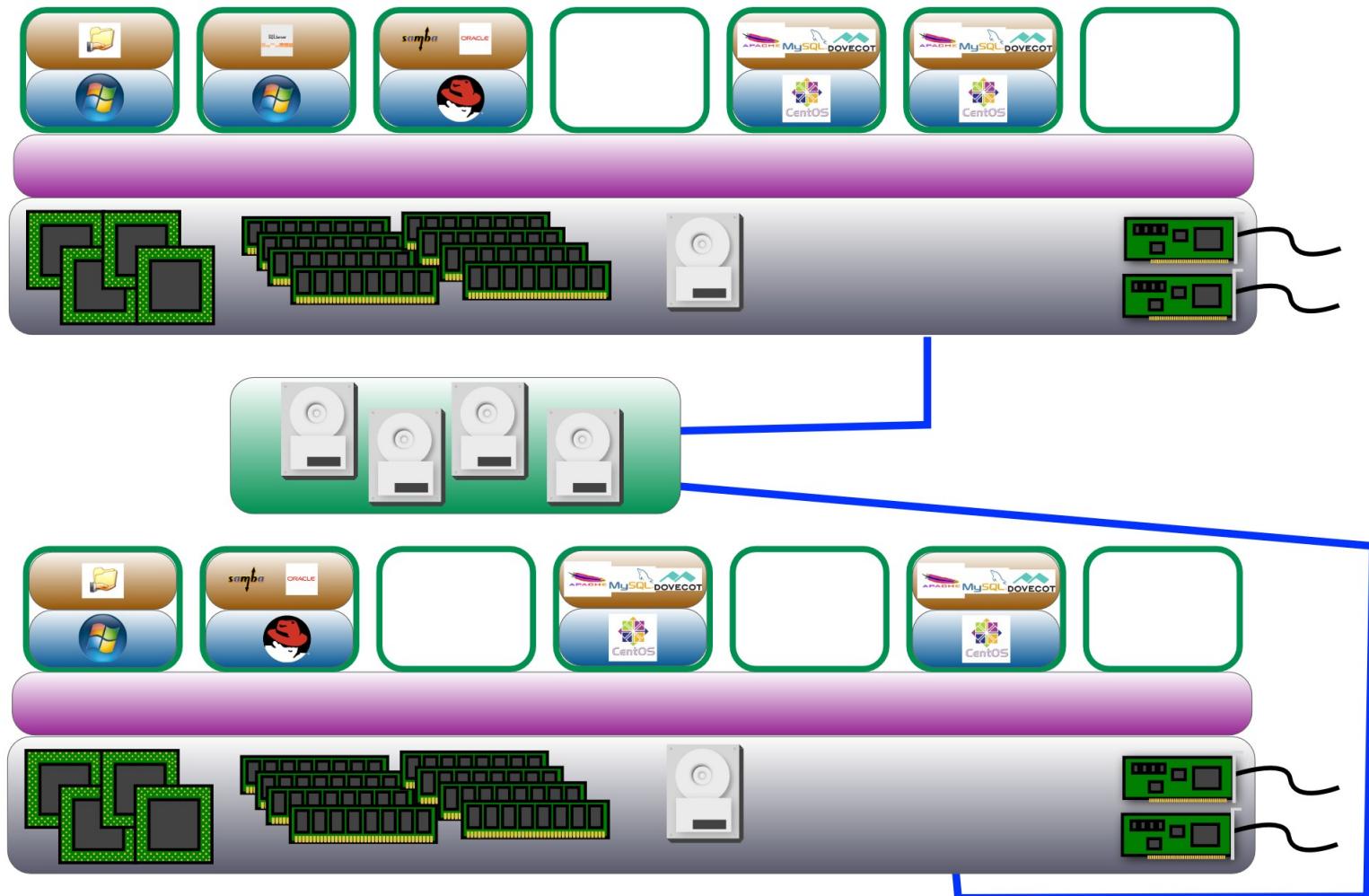
- Data files

In other words, a VM can be as simple as 2 files!!

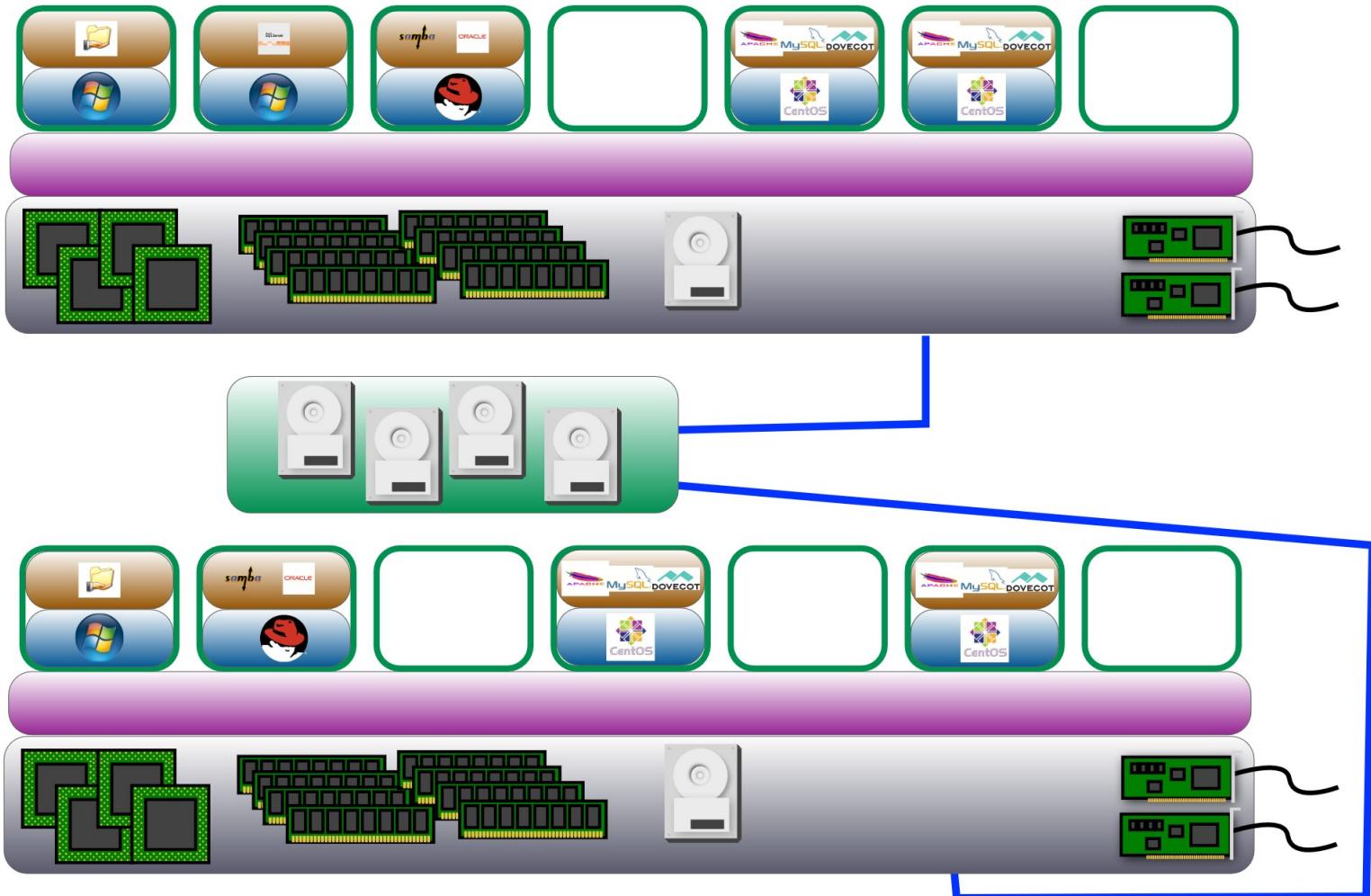
# Consolidation



# Consolidation with SAN

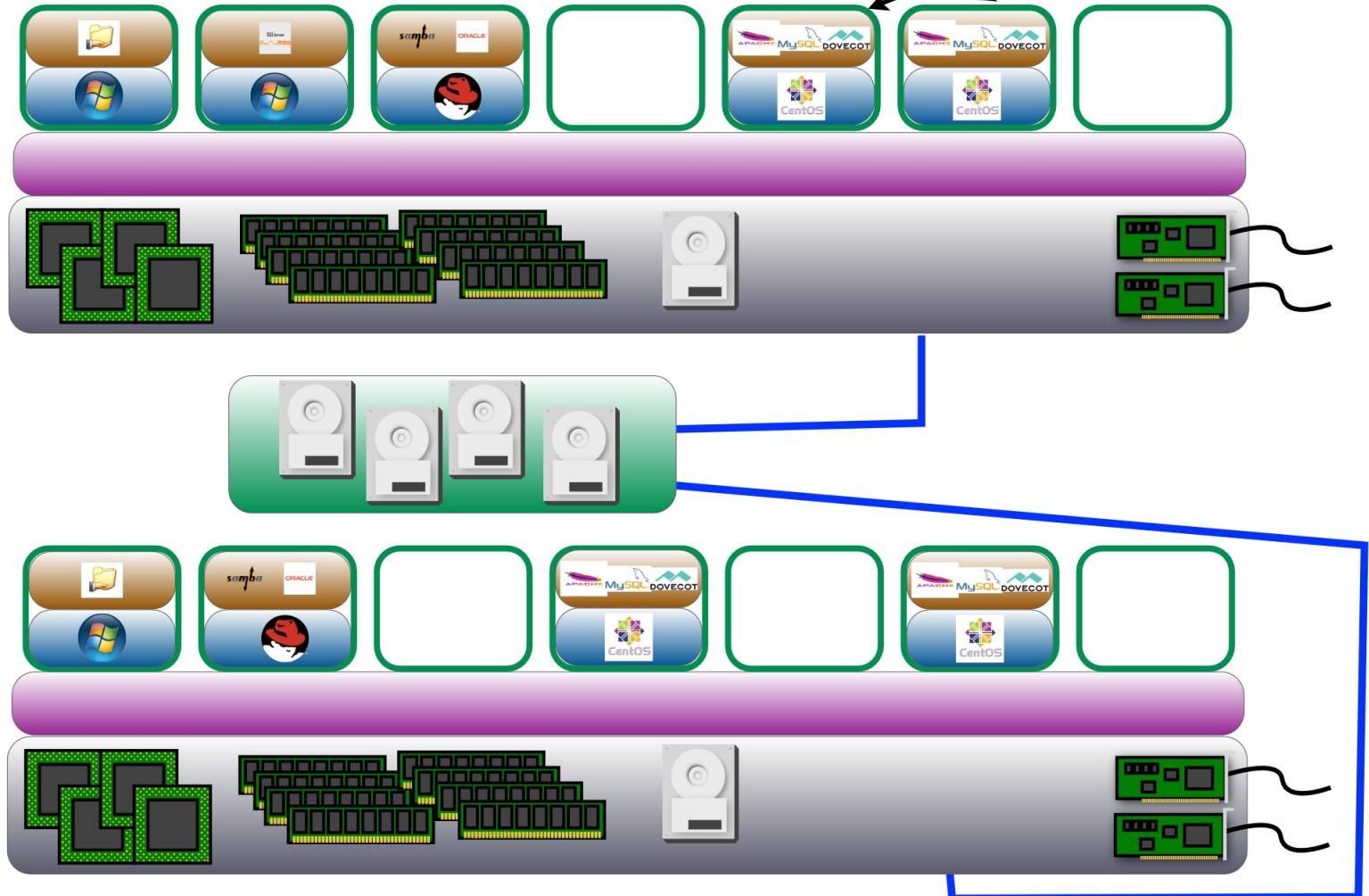


# Live Migration



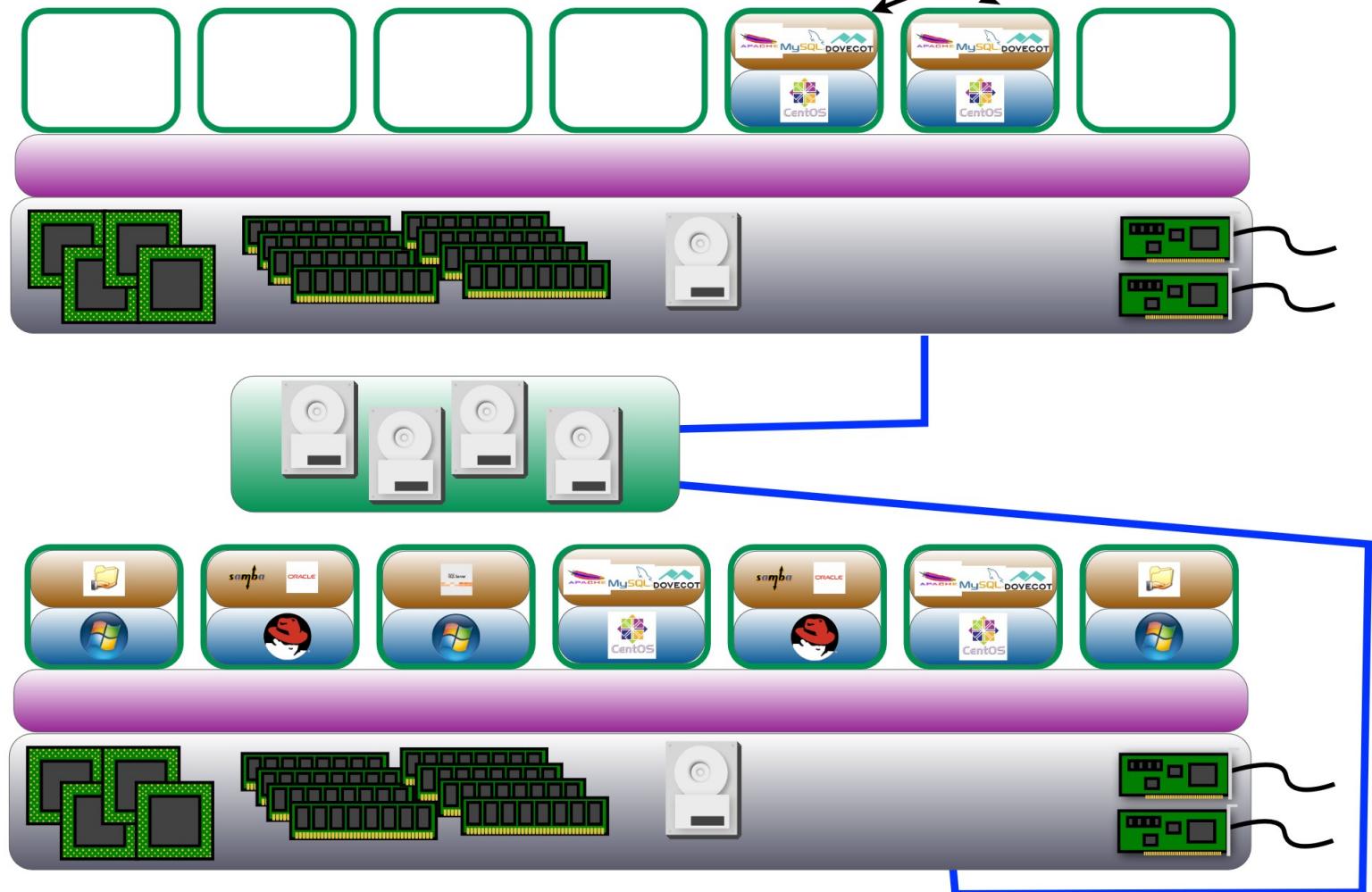
# Live Migration

High loads!



# Live Migration

High loads!



# Why Virtualize?

Better utilization of hardware

Less hardware → reduced data center needs

Flexibility

Testing and development

Disaster recovery

Increased performance

Scalability

Easier isolation

Easier deployment

Cost savings

# Major Platforms

VMware vSphere/ESXi

Microsoft Windows Server/Hyper-V

Citrix XenServer/Xen

Red Hat Enterprise Virtualization/KVM

# VMware Features

## Management

- Hot Add - add resources while VM runs
- vMotion - move live VMs between hosts
- Storage vMotion - move live virtual disk files between devices
- Replication - template & clone VMs and virtual disks
- Snapshots - backup of current machine state and storage for reversion

## Reliability & Load Balancing

- High Availability - automatic restart of VMs
- Fault Tolerance - run pairs of VMs redundancy to protect against hardware host failures
- Distributed Resource Scheduler - load balancing and automatic vMotion
- Storage DRS - automatic optimization of storage device selection
- Affinity Policies - keep sets of VMs together and/or isolated on hosts

## Networking

- Distributed Switch - virtual Ethernet switch distributed across hosts
- NSX - virtual routing, security, and policy based network management

# Virtualization & “The Cloud”

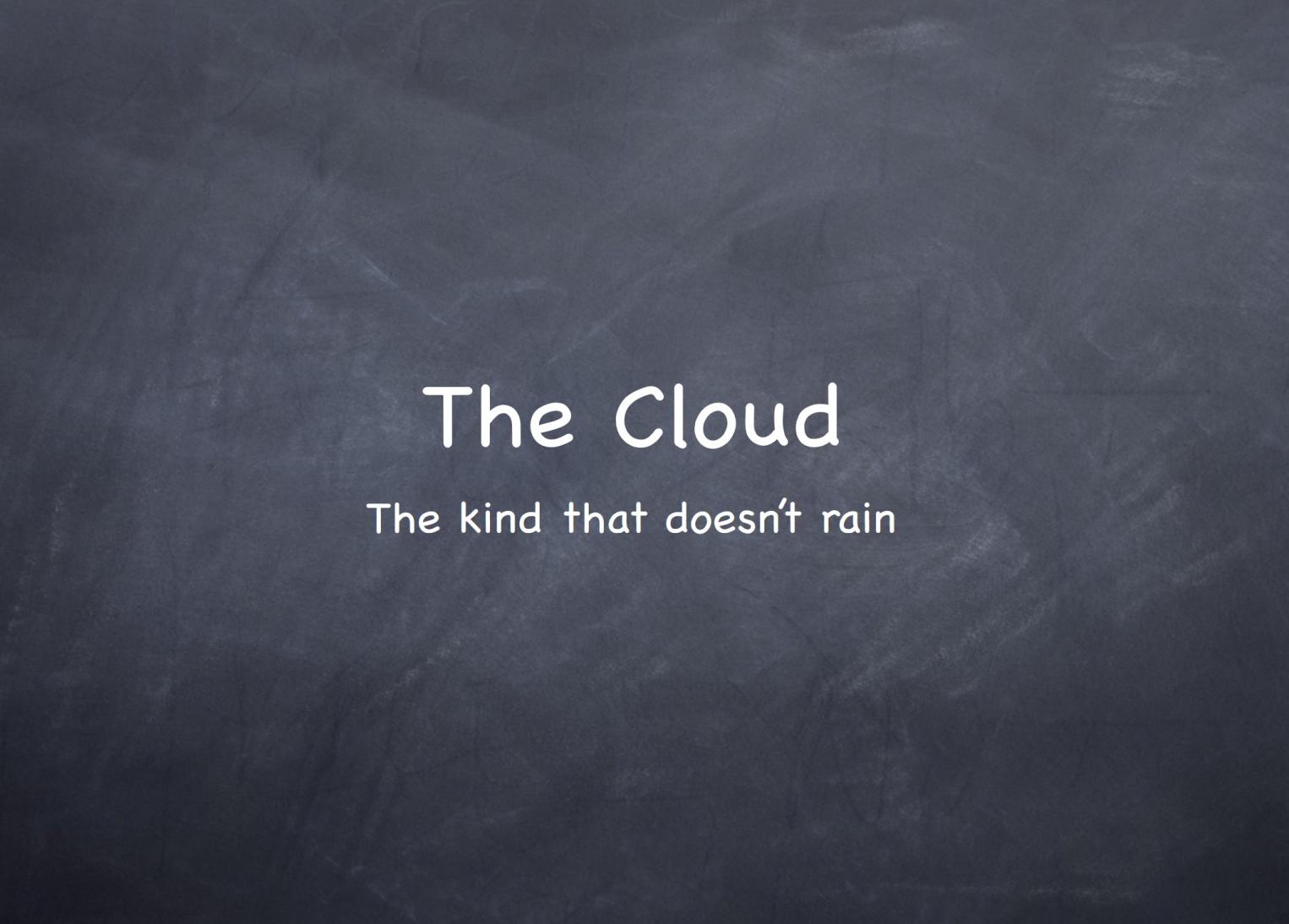
Local Hardware



The Cloud



# “The Cloud”



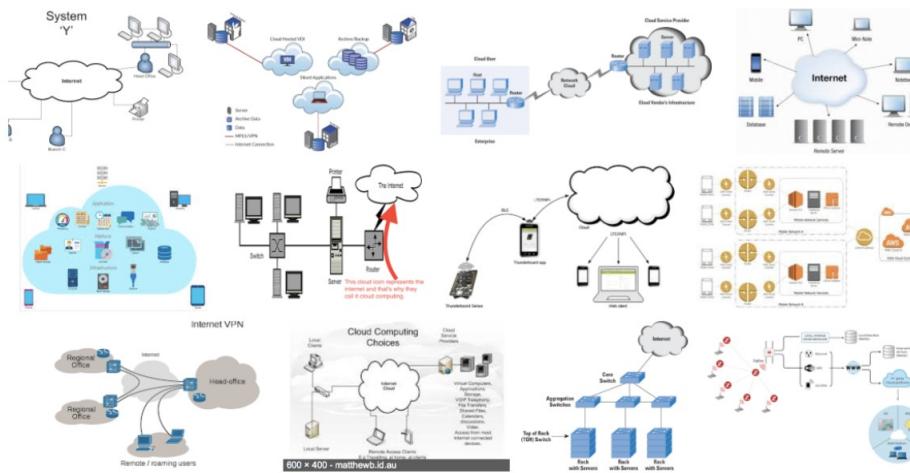
The Cloud

The kind that doesn't rain

# What's “The Cloud”?

IT stuff that someone else runs for you. Period.

Why the “cloud”?



Lazy diagram creators!

# Virtualization & “The Cloud”

Local Hardware



The Cloud



# “Cloud” Services

IT stuff that someone else runs for you

Software as a Service

Application is hosted and managed by the vendor

Platform as a Service

OS or some development platform (e.g. Salesforce) is provided by the vendor on which you can design and run your own applications

Infrastructure as a Service

Vendor supplies raw compute and storage on which you can create and run VMs that you manage

# “Cloud” Services

## Software as a Service - SaaS

Application is hosted and managed by the vendor

Your organization may need to administer the application (setup users, assign privileges, configure settings, integration, etc), but you don't ever touch the underlying OS

Examples (just at UNH and not a full list!):

myCourses/Canvas, Box, [wildcats.unh.edu](mailto:wildcats.unh.edu) email, Zoom, Salesforce, Blue (course evals), Office web apps, Kaltura (media hosting), Qualtrics (surveys), myUNH portal, Handshake (jobs/careers)

# “Cloud” Services

## Platform as a Service - PaaS

OS or some development platform is provided by the vendor on which you can design and run your own applications

Includes database services, frameworks, libraries, etc all configured and manage for you

Your organization designs, builds, and runs your application using these tools

### Examples:

Microsoft Azure

Salesforce Platform (aka force.com)

# “Cloud” Services

## Infrastructure as a Service - IaaS

Vendor supplies raw compute and storage on which you can create and run VMs that you manage or store data

May include some tools to aid in deployment of standardized templates or preconfigured machines, but ultimately your responsible for everything that's not the core hardware (OS on up)

### Examples:

AWS EC2, S3

Google Compute Engine

# Types of “Cloud”

## Public Cloud

Someone else runs the cloud services for you

You share resources in some way with others

## Private Cloud

Resources are limited to your organization's use, but provisioned and managed like a “cloud”

Usually runs in your own data center spaces, but you could pay someone else to provide you a private (not shared) cloud

## Hybrid Cloud

Using both

For example, normally running private, but can scale up and out to public cloud services when there's demand

# “Cloud” Pros & Cons

## Pluses

Nearly limitless capacity

Very quick to setup and use

Rich variety and levels of services

Pay for what you use only

Scale up/scale down

Possibly more secure

## Minuses

Dependent on service providers

Lack of direct control

Shared resources

“Not like the old way I used to do it”

Possibly less secure

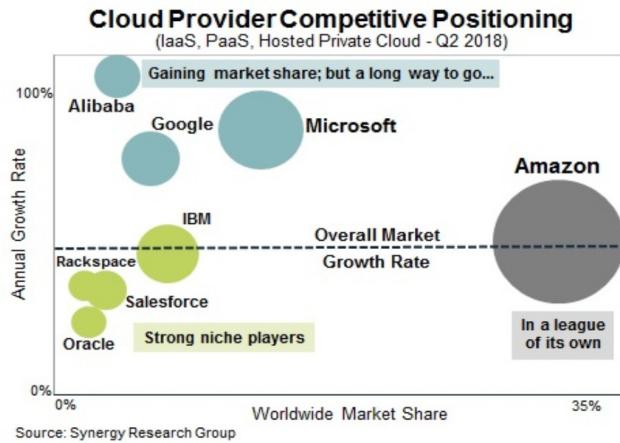
# “Cloud” Example - AWS



AWS started in 2006 as a small side business of amazon.com reselling their excess server capacity

Has become the largest player in the “cloud” space

Now 90+ separate services



<https://www.srgresearch.com/articles/cloud-revenues-continue-grow-50-top-four-providers-tighten-grip-market>

# “Cloud” Example

## AWS Key Services

EC2 - Elastic compute cloud - run Linux or Windows VMs, varying resource provisioning

S3 - Simple storage service - object storage

RDS - Relational database service - SQL-based database hosting

ELB - Elastic load balancer - distribute traffic to multiple servers

CloudFront - content delivery network - scale to global, local deliver

Lambda - “microservices” functions run on demand without needing to configure/manage servers

# Still not sure what a “Cloud” is...

<https://www.youtube.com/watch?v=iDbyYGrswtg>

# Want to try AWS “Cloud”...

“Getting Started with Amazon Web Services”  
seminar from Harvard CS50 course by Leo  
Zhadanovsky, AWS

<https://www.youtube.com/watch?v=VgzzHCukwpc>

# Homework Assignments

- Assignment #01 - Part 1 - Late (-10%)
- Assignment #02 - Current Event #01 - Due 05-Oct-2021
- Readings (see myCourses)