

Cloud Computing

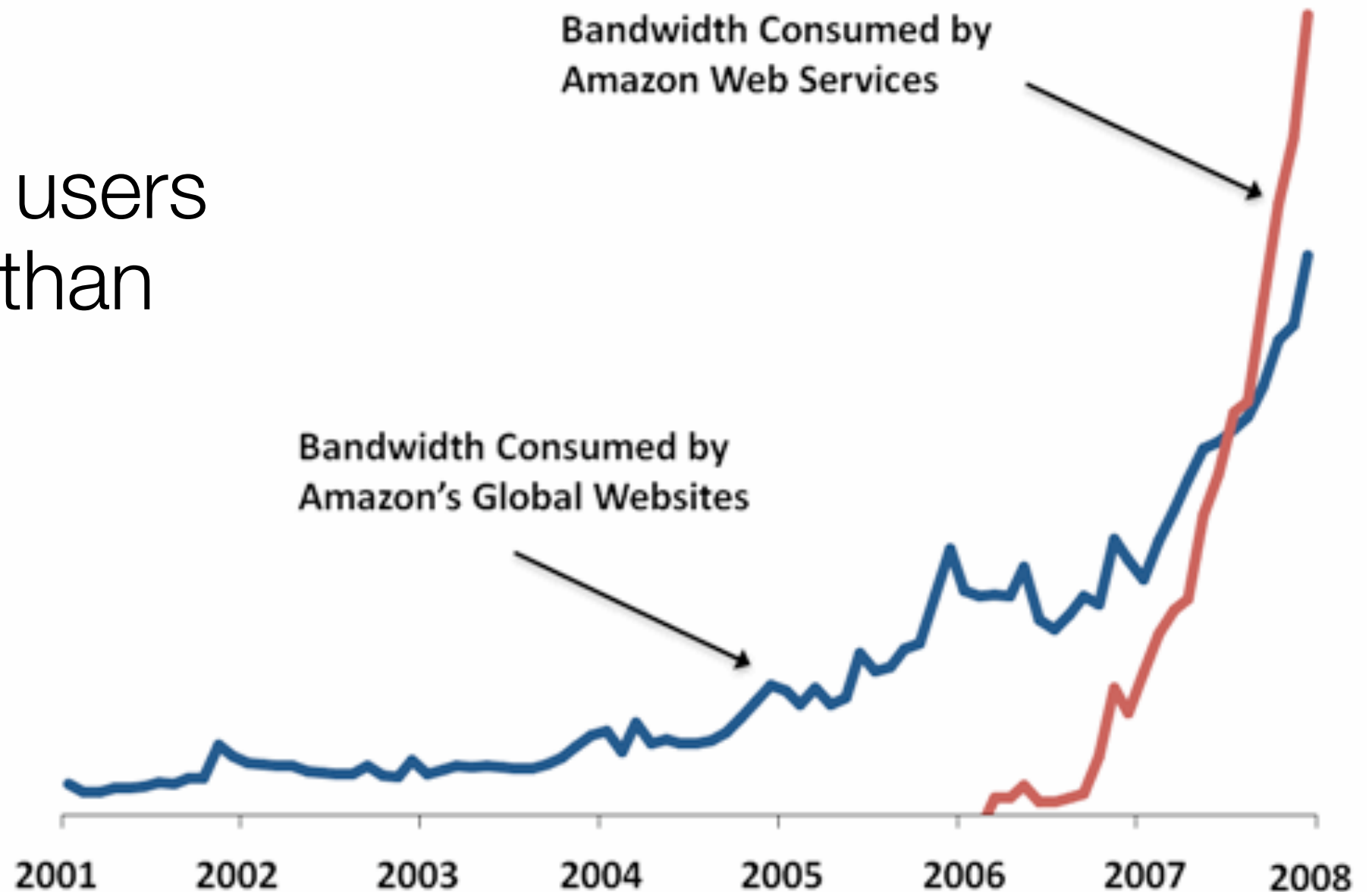
GW Advanced Networking and
Distributed Systems

Tim Wood and Lucas Chaufournier

Amazon's Cloud

Amazon built its cloud platform so that other people could pay for its infrastructure during the rest of the year...

Now its cloud users are far bigger than its own sites



Scale Estimates

- 1.5-2 million servers - Bloomberg 2014
- 50-80K per data center, 68 total data centers = 3.4-5.4 million
- re:Invent 2016

*Every day Amazon adds as many servers as it had in **2000** (when it was a **\$2 billion** company)
— talk at UW **2011***

*Every day Amazon adds as many servers as it had in **2005** (when it was a **\$8.5 billion** company)
— AWS re:Invent **2016***

Why use the cloud?


- Pay-as-you go
- Expand quickly on demand
- Don't need to worry about (many) IT issues
- Cheap! (?)

... but is the cloud perfect?

[spoiler alert] no.

Types of Clouds

Software as a Service (SaaS)



Office apps, CRM

for anybody

Platform as a Service (PaaS)



Software platforms

for programmers

Infrastructure as a Service (IaaS)



Servers & storage

for programmers and sys admins

↑
Increased
Cloud
Automation

↓
Increased
Customer
Control

Infrastructure as a Service (IaaS)

Infrastructure clouds rent **computing resources***

- Connect to a server remotely
- Configure OS and install whatever applications you want

Great flexibility for cloud user

Less management handled by cloud operator

**Your own computer or disk
on demand!**

* You aren't getting a full computer, you are getting a virtual machine, container, virtual disk, etc.

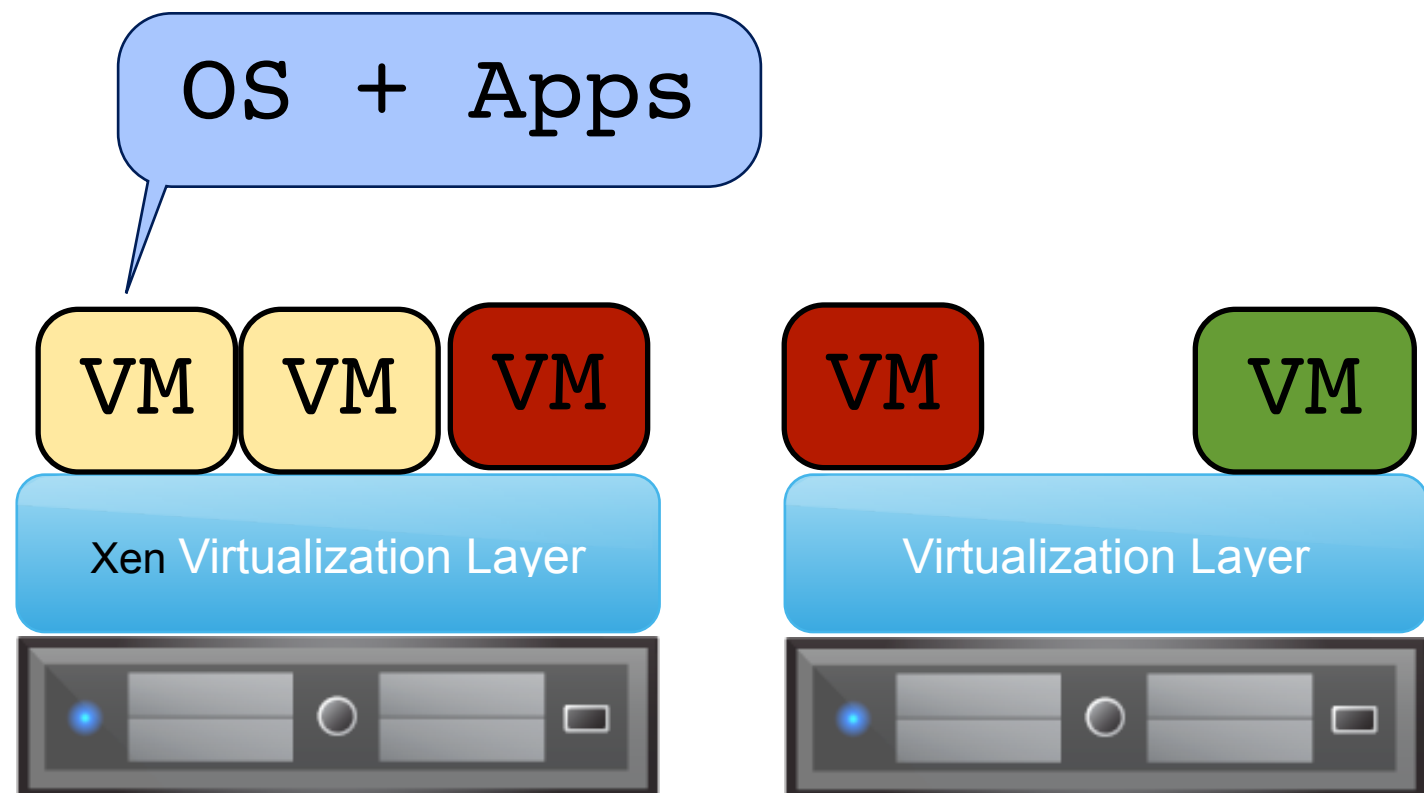
Virtual Machines

Virtualization is used to **split up** a physical server

- Allows multiple customers to share one machine
- Simplifies management since VMs are not strictly tied to HW
- Provides strong security and performance isolation between cloud users



Cloud Data Center



Amazon EC2

- Infrastructure as a Service Cloud (IaaS)
- Can rent server and storage resources

	Description	Cost
t3.Micro	1GB RAM, up to 1 core, no storage	\$0.01 / hour
m5.2xlarge	32GB RAM, 8 cores, no storage	\$0.38 / hour
c5d.24xlarge	192GB RAM, 96 cores, 4xSSDs	\$4.06 / hour
EBS	Network attached storage	\$0.10 / GB per month

EC2 Demo

<https://www.awseducate.com/signin/SiteLogin>

Compare EC2 VMs: **t3.micro** vs **m5.2xlarge**

Instance details:

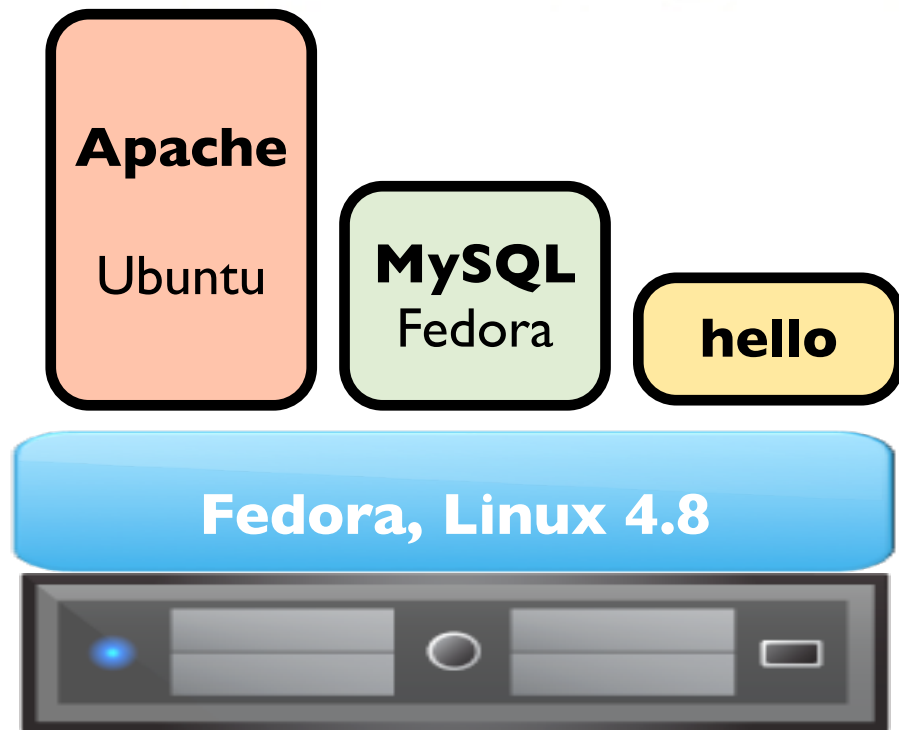
- Auto-assign Public IP -> Enable

```
sudo apt-get update
```

```
sudo apt-get install -y sysbench
```

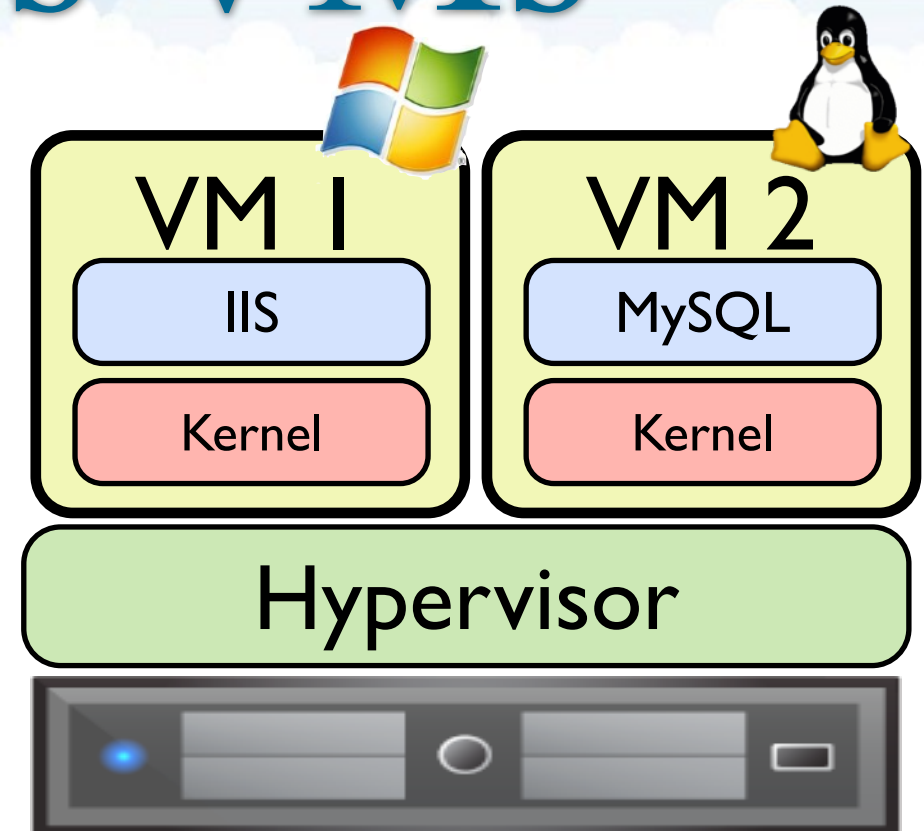
```
sysbench --test=cpu --num-threads=100 --max-requests=50000 run
```

Container vs VMs



Containers

- A group of applications, files, and resources
- Share the underlying OS kernel
- Lightweight



Virtual Machines

- A full virtual computer including OS, applications, files, and resources
- Strong isolation between VMs

Process Isolation

Processes

- OS provides isolation

Isolated:

- Memory

Shared:

- File system
- Network
- Devices
- OS Kernel



Containers



docker

Containers

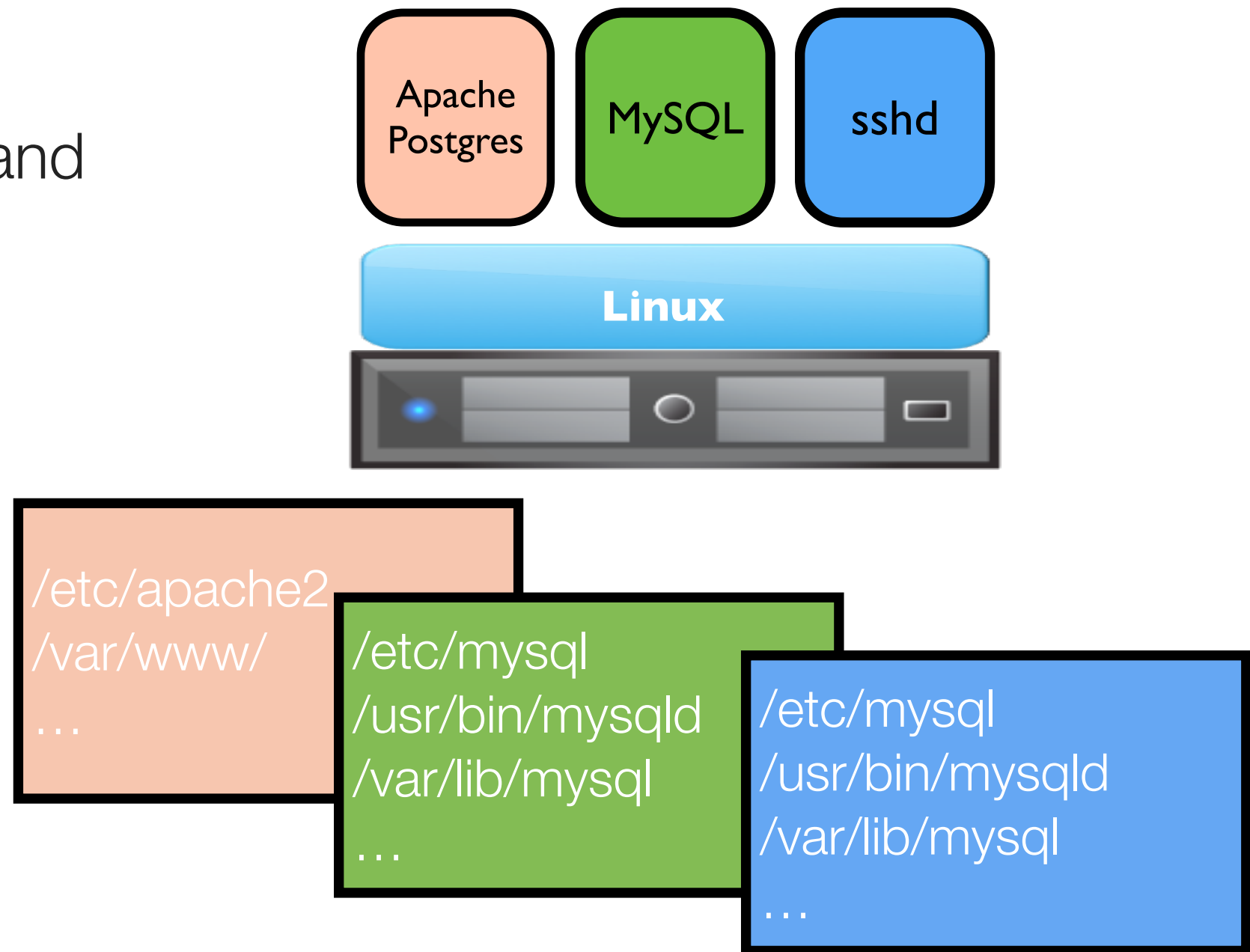
- Namespace-based isolation using LXC and cgroups

Isolated:

- Memory
- File system
- Network
- Devices

Shared:

- OS Kernel



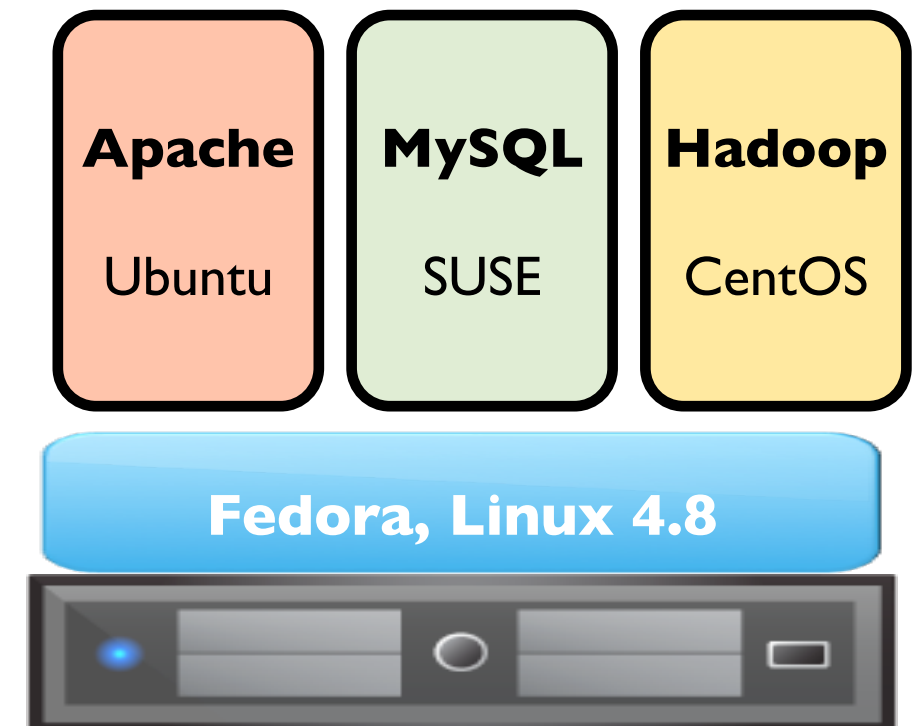
Container Packaging

Deployment - big benefit of containers/virtualization

- Lets you package up an application and all of its requirements
- Even the distribution and 3rd party utilities!
- Very helpful for system administrators

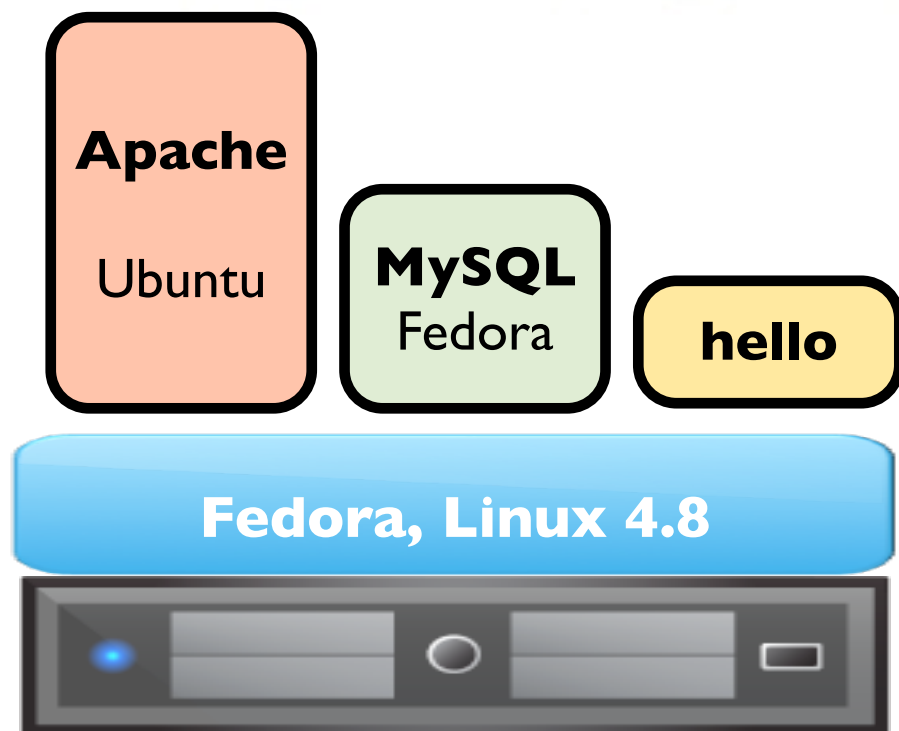
Container “image” includes:

- Linux distribution base files
- Dependency libs/utils
- Configuration files
- Application to run



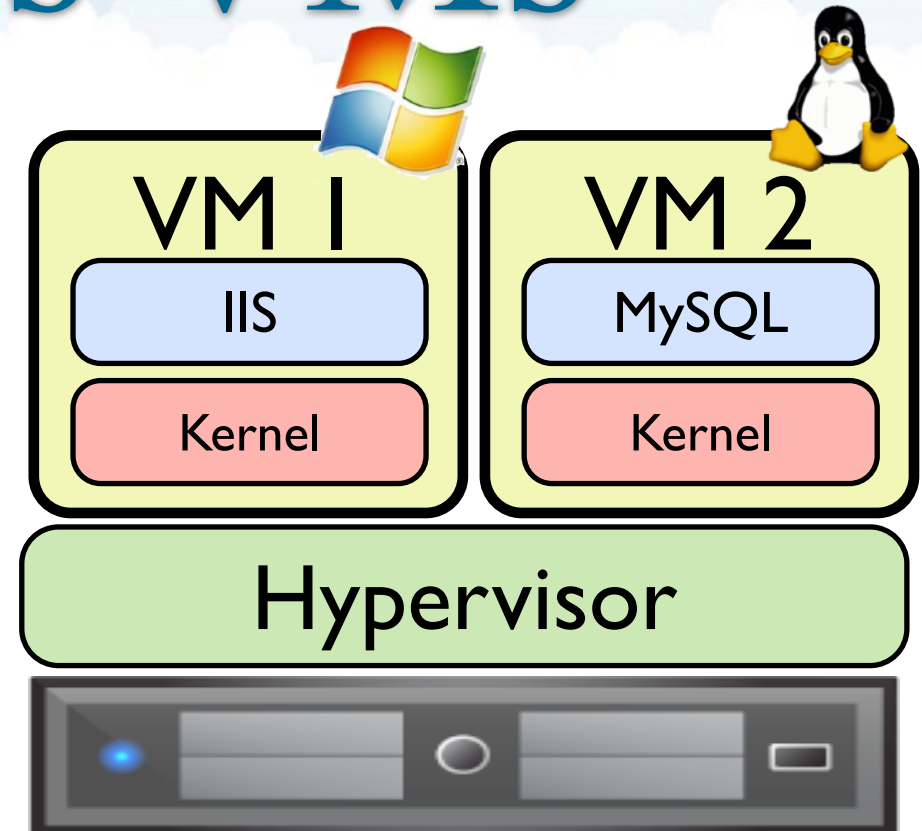
Does not include...?

Container vs VMs



Pros:

- lightweight (no duplication)
- less resource consumption
- easier to deploy
- specify resources just for application
- faster startup time



Pros:

- stronger isolation
- different kernel versions/Oses
- fault tolerance / isolation
- combine with containers

Elastic Load Balancer

Amazon also provides infrastructure to help you scale

- Distributes incoming requests across multiple VMs/containers

Can operate at...

Layer 4 LB

- Load balanced based on TCP connections
- Redirect packets by only looking at packet header
- curl http://**192.168.1.1**/index.html (only considers address)

Layer 7 LB

- End incoming TCP connection and create connection to dest
 - Higher overhead than Layer 4 LB
- application level / HTTP level
- request **index.html** -> server 1
- request **buy.php** -> server 2

ELB Demo