14-848 Cloud Infrastructure

INTRODUCTION TO THE CLOUD

Agenda

- Cloud Computing Introduction
  - What is Cloud Computing?
  - What are the Cloud Characteristics?
- Cloud vs Conventional Computing
- Cloud Benefits
- Cloud Computing Enablers
- Cloud Computing Service Model

What is the Cloud?

- It's a cluster!
- It's a supercomputer!
- It's a datastore!
- It's superman!

- None of the above?
- All of the above?

- In simple words:
 - Cloud = Lots of storage + compute cycles nearby + network bandwidth
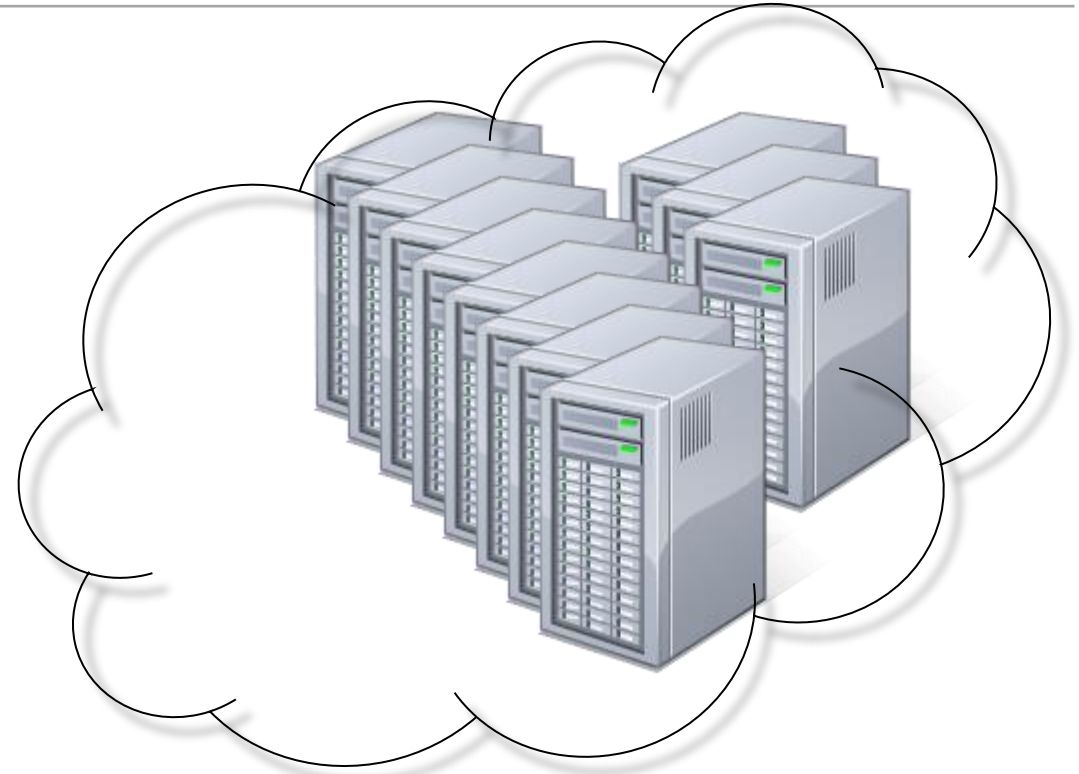
Cloud Computing – NIST Definition

A *model* for enabling convenient, on-demand network access to a *shared* pool of *configurable computing* (e.g., servers, storage, applications, and services) and networking resources that can be *rapidly provisioned* and *released* with *minimal management* effort or service provider interaction

Cloud Use
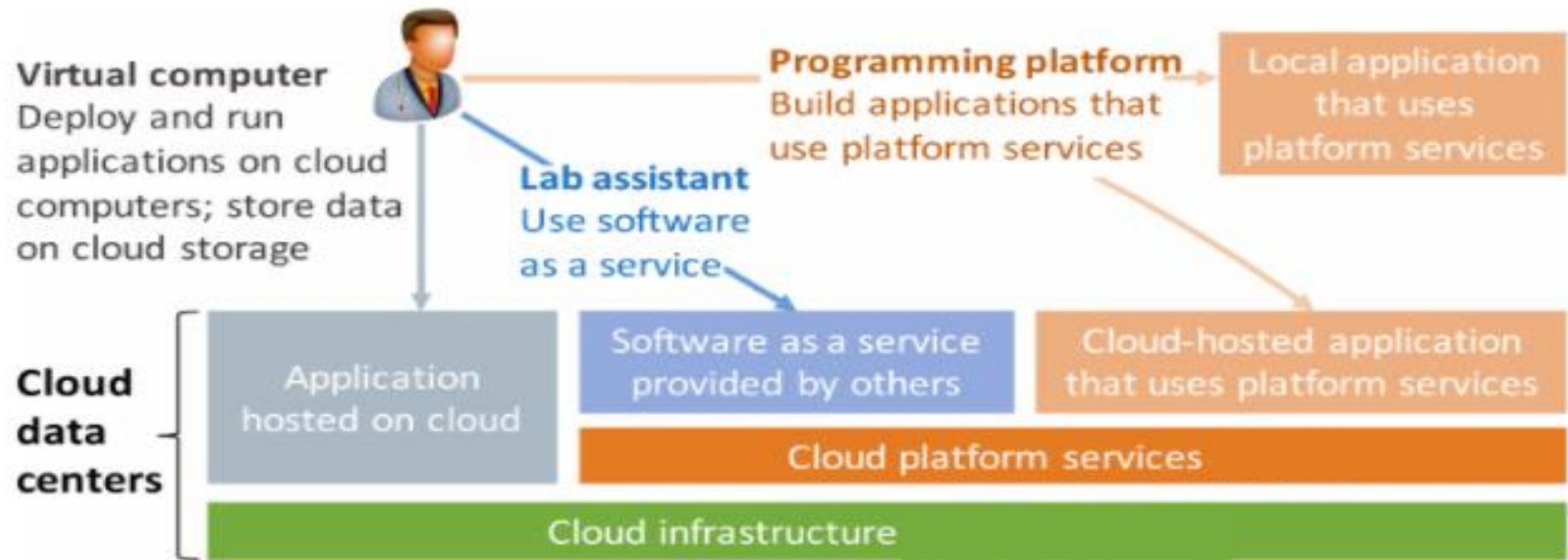
From Cloud Computing for Science and Engineering by Gropp and Lusk

Scientists can use clouds in three distinct ways:

- As a source of on-demand computing and storage on which to run their own software (left);
- As a source of software that can be run over the network (center)
- As a source of new platform capabilities that can allow development of new types of software (right)

What is Cloud Computing in the REAL WORLD?

"Cloud" refers to large Internet services running on 10,000s of machines (Amazon, Google, Microsoft, etc)

"Cloud computing" refers to services by these companies that let external customers rent cycles and storage

- Amazon EC2: virtual machines at 8.5¢/hour
- Amazon S3: storage at 21¢/GB/month
- Google Cloud AppEngine
- Windows Azure

Why Do We Care about Cloud Computing?

- Dropbox

- Google Drive
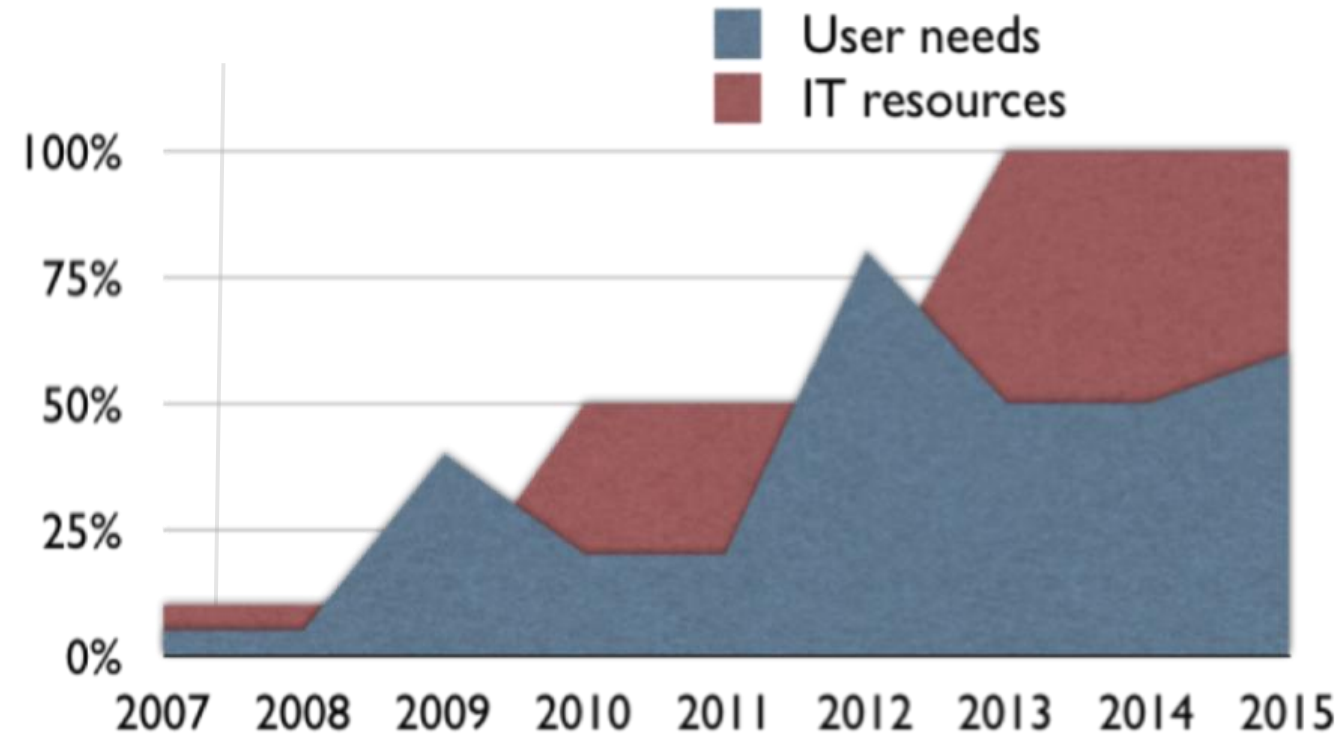
- Microsoft OneDrive

- Apple iCloud

- Netflix - hosted on AWS
- Google search – Google Cloud
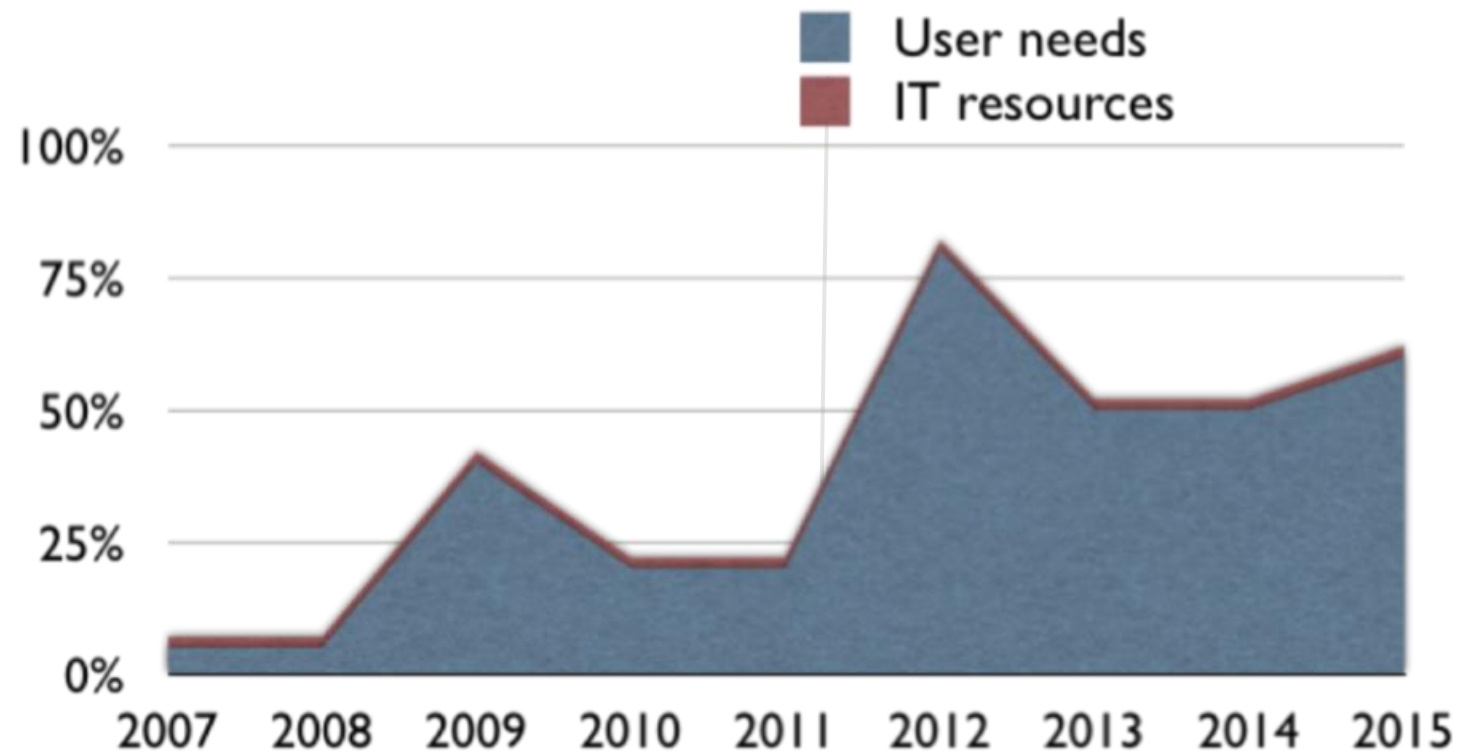- Google Docs, Sheets, and Slides
- Facebook
- Skype
- Twitter

Conventional Computing Infrastructure - Needs vs IT RESOURCES

Moore's law

- Storage Doubling Period: 12 months

- Bandwidth Doubling Period: 9 months

- CPU Computing Doubling Period: 18 months

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Cloud Computing Infrastructure - Needs vs IT RESOURCES

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Conventional Computing Infrastructure vs Cloud Computing Infrastructure

Conventional	Cloud
Manually Provisioned	Self-provisioned
Dedicated Hardware	Shared Hardware
Fixed Capacity	Elastic Capacity
Pay for Capacity	Pay per Use
Capital & Operational Expenses	Operational Expenses
Managed via System administrators	Managed via APIs

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Cloud Benefits

CLOUD COMPUTING MAKES DISASTER RECOVERY SIMPLE!
Cloud-based backup solutions are cheap and reliable.

16.76% average reduction in IT maintenance costs

CLOUD COMPUTING REDUCES HARDWARE COSTS.
15.07% average reduction

CLOUD COMPUTING TAKES THE HASSLE OUT OF COLLABORATION
18.80% average increase in process efficiency

CLOUD COMPUTING ALLOWS BUSINESS OWNERS AND EMPLOYEES TO WORK FROM ANYWHERE.

CLOUD COMPUTING OFFERS TOTAL FLEXIBILITY.
Business owners can scale up their cloud capacity to meet the growing needs of their operation.

CLOUD COMPUTING OFFERS AUTOMATIC SOFTWARE UPDATES.

10 AWESOME BENEFITS of CLOUD Computing Services

CLOUD COMPUTING OFFERS GREATER PROTECTION AND SECURITY MEASURES.

19.63% average increase in company growth following the implementation of cloud services

CLOUD COMPUTING HELPS TO FUTURE-PROOF ANY MODERN BUSINESS

CLOUD COMPUTING HELPS TO PROTECT THE ENVIRONMENT.
Less paper waste and less need for plastic hard drives. Reduction in carbon footprint.

Cloud Computing Service Model

Software as a Service

Platform as a Service

Infrastructure as a Service

Metal as a Service

SaaS: Software as a Service

- Provided with access to application software in the cloud

  - On-demand software

- Most applications can be run directly from web browser

- Largest cloud market

- Examples: Google Apps, Microsoft Office 365, Oracle's Netsuite, SAP's Concur, Cisco WebEx, GoToMeeting

Software
(as a Service)

Applications

Data

Runtime

Middleware

O/S

Virtualization

Servers

Storage

Networking

Managed by vendor

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PaaS: Platform as a Service

- Provides computing platforms which typically includes operating system, programming language, execution environment, database, web server, etc. to build cloud applications.

- Applications using PaaS inherit cloud characteristic such as scalability, high-availability, multi-tenancy, SaaS enablement, and more.

- Examples: Google App Engine, AWS Elastic Beanstalk, Salesforce.com, Amazon EMR, MS Azure HDInsight, GCP Dataproc

IaaS: Infrastructure as a Service

- Offers storage and computing resources that developers and IT organization use to deliver custom business solutions

- Examples: Amazon EC2, VMWare vCloud, GCP Compute Engine
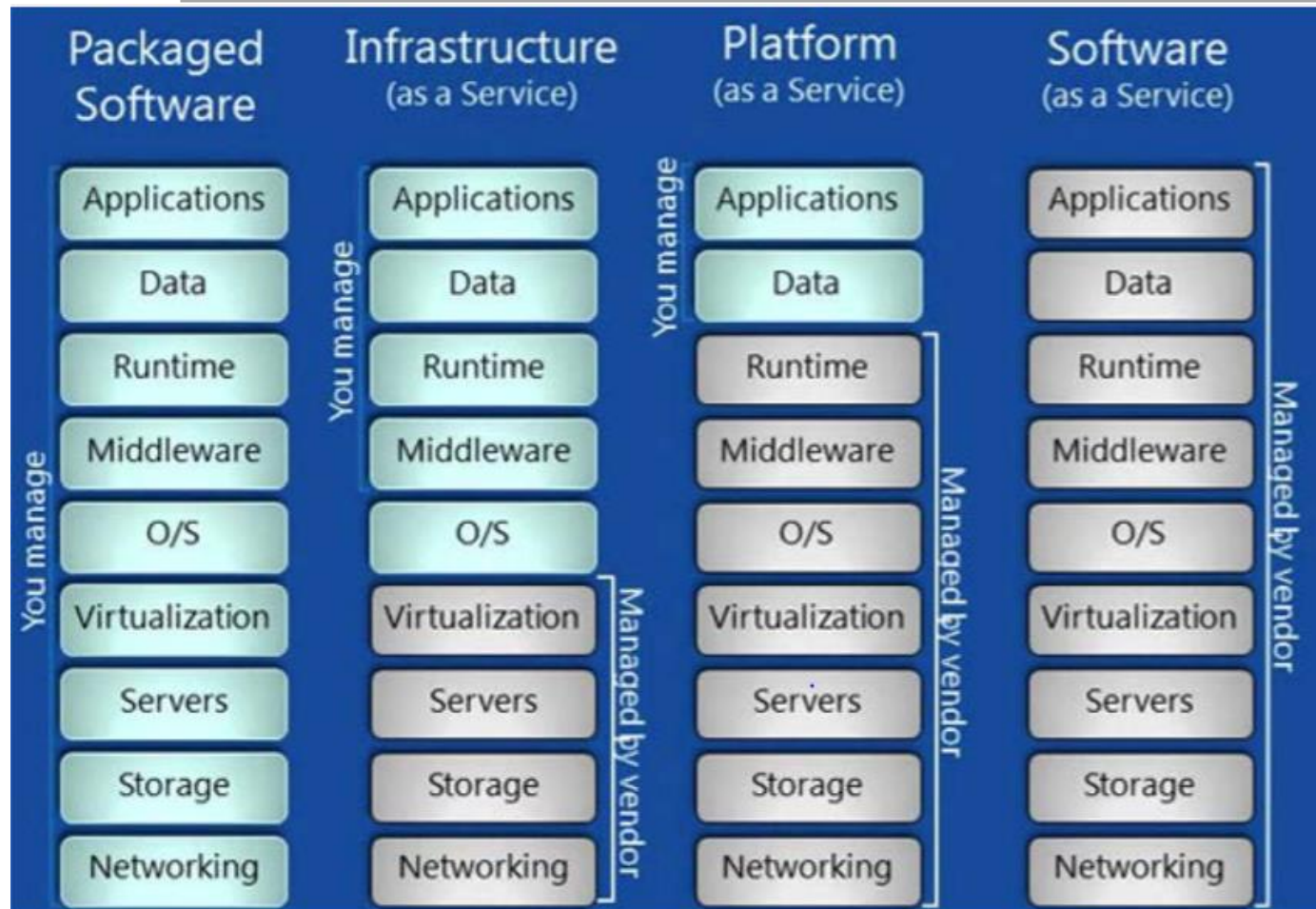

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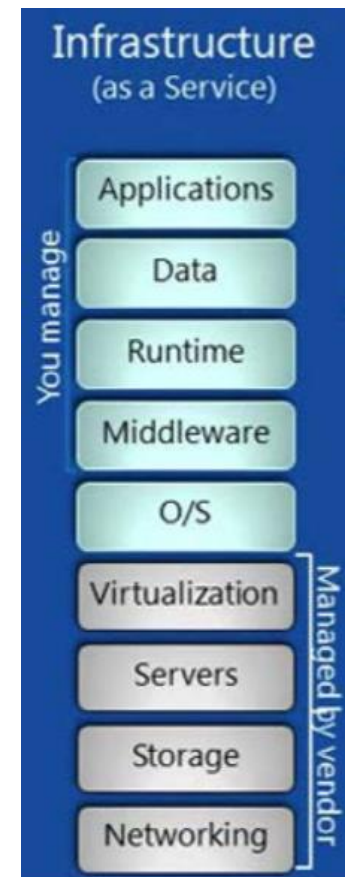
MaaS: Metal as a Service

- Combines the flexibility and scalability of the cloud with the ability to harness the power of physical servers.
- Examples: Juju

- For more information, watch this video (optional): https://www.youtube.com/watch?time_continue=280&v=FBCKCO45xIw
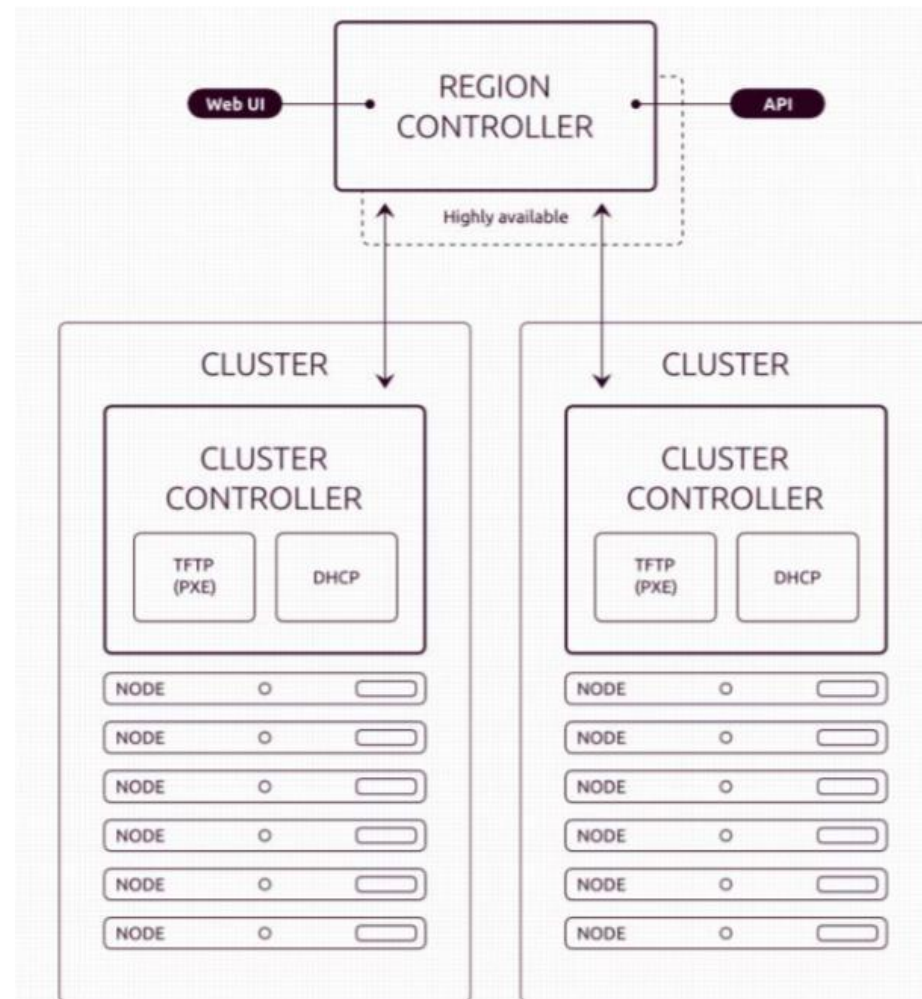
Cloud Computing Service Model

In MAAS

🔸 You will have the option to control everything!

PaaS or IaaS?

Vendor Lock-in: the ability to use "what you manage" in cloud environment with different cloud provider.

- PaaS may lock-in applications by requiring users to develop apps based on their specific APIs.

- If you are using PaaS, it might be difficult to switch to different vendor.

Development Tools

- PaaS providers usually allow a set of development tools for their users to shorten development time.

- Another trick for vendor lock-in!

Cloud Computing Enablers

Data Center + Virtualization

Next Steps

- Take the Quiz: quiz access code is released in the lecture.
- Submit the first homework
    - HW-1 is released today at 6pm ET/3pm PT.
    - Submit HW-1 by Thursday 1/26 11:59PM ET, 8:59PM PT