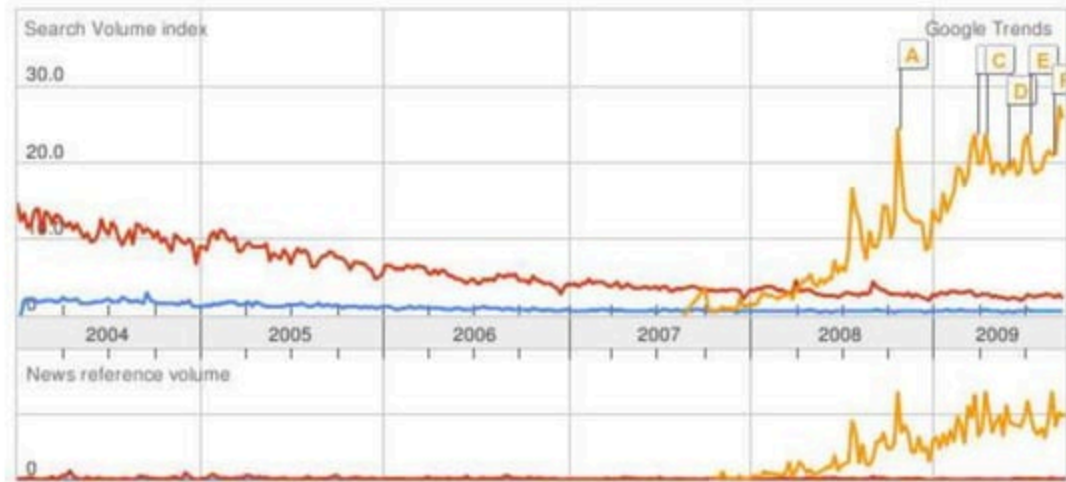


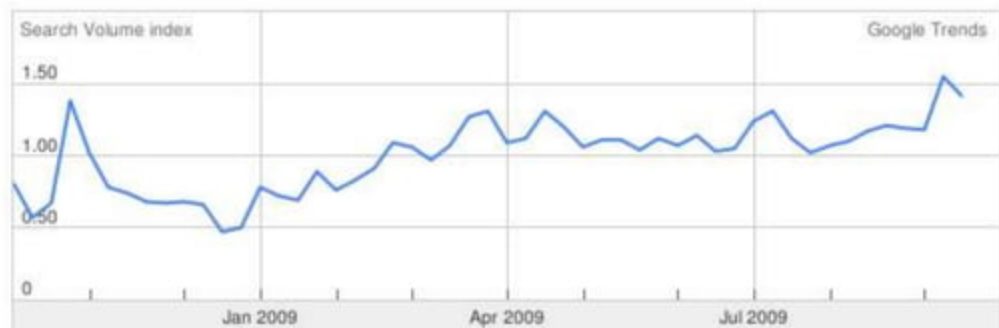


Ninh V. Nguyen
ninh.nv@gmail.com

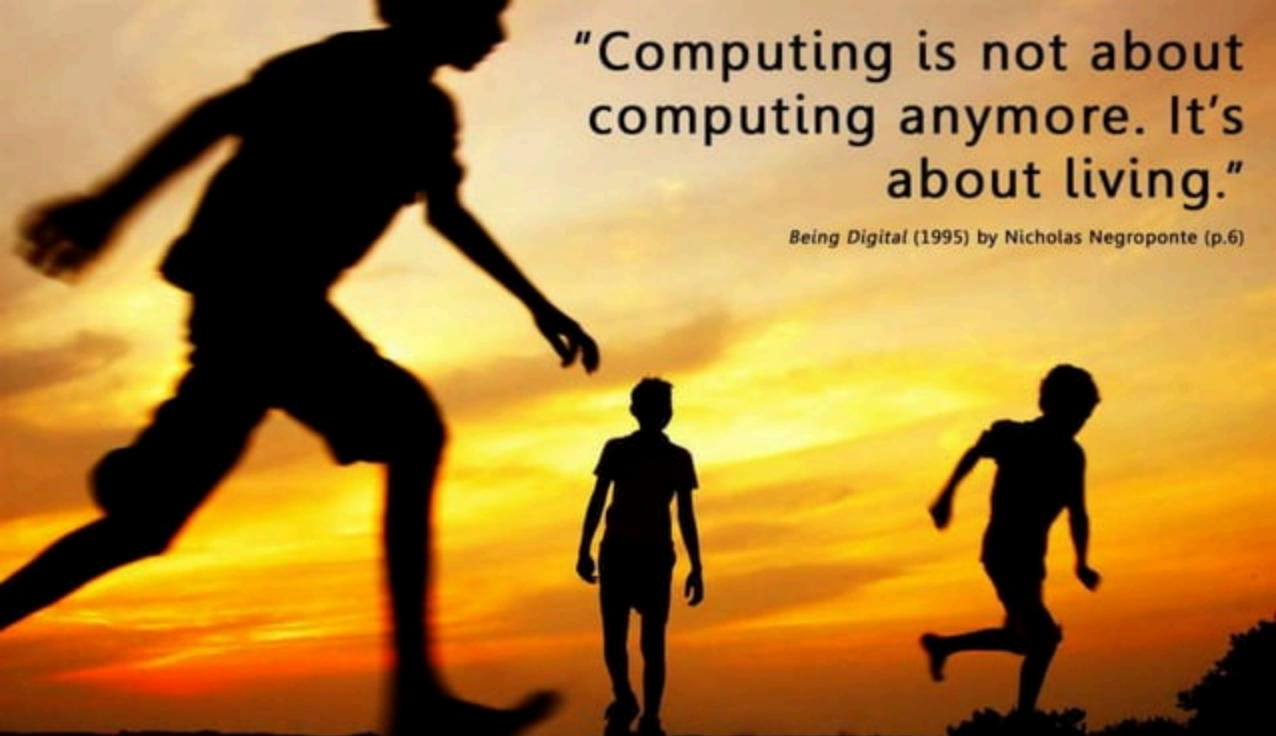
The Hype



Cluster Computing
Cloud Computing
Grid Computing



Google news



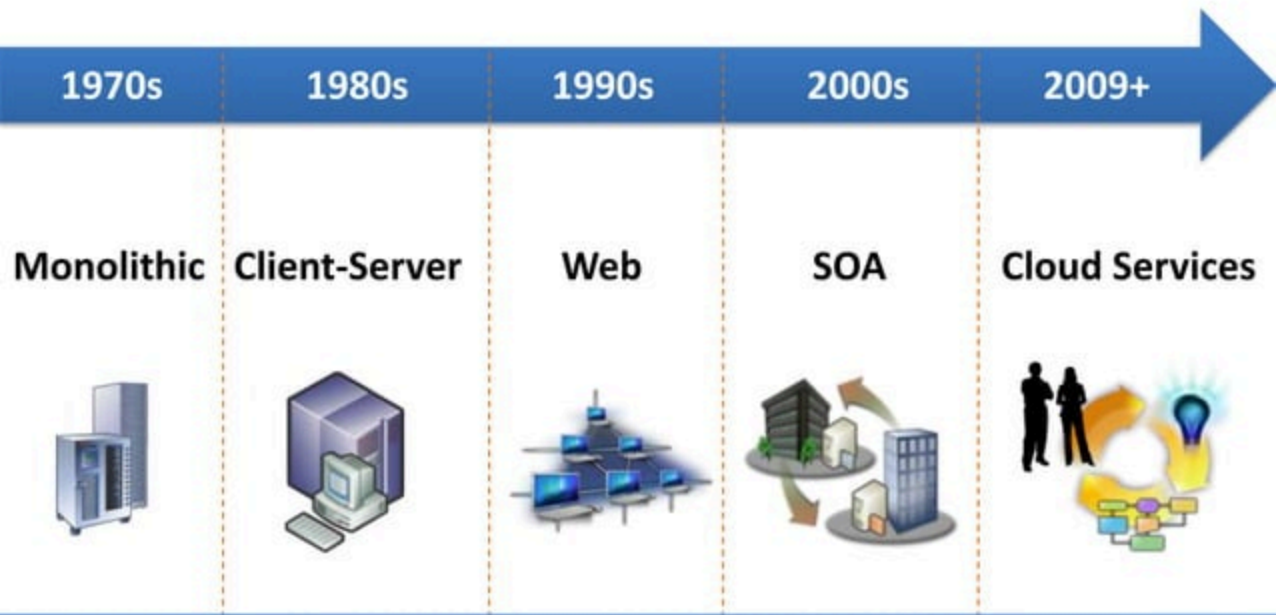
"Computing is not about
computing anymore. It's
about living."

Being Digital (1995) by Nicholas Negroponte (p.6)

"What the hell is Cloud Computing?"

- Larry Ellison

5th Generation of Computing



Wikipedia's Definitions

Cloud computing is a computing paradigm shift where computing is moved away from personal computers or an individual server to a "cloud" of computers.

– 12/2007

Cloud computing is Internet-based ("cloud") development and use of computer Technology ("computing"). The cloud is a metaphor for the Internet, based on how it is depicted in computer network diagrams, and is an abstraction for the complex infrastructure it conceals.

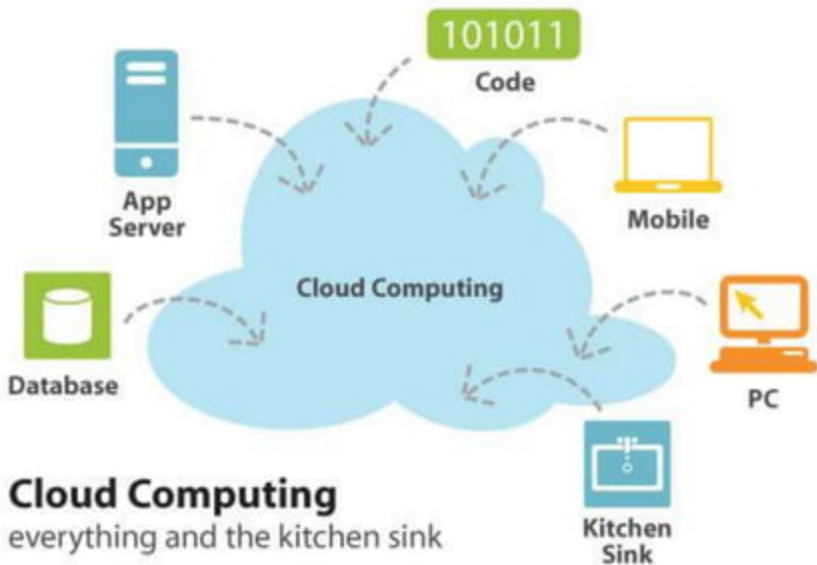
– 12/2008

Cloud computing is a style of computing in which dynamically scalable and often virtualized resources are provided as a service over the Internet.

– 6/2009

Cloud computing is an example of computing in which dynamically scalable and often virtualized resources are provided as a service over the Internet.

- Now



Common implies multi-tenancy, not single or isolated tenancy

Location-independent

Online

Utility implies pay-for-use pricing

Demand implies ~infinite, ~immediate, ~invisible scalability



Cloud Computing Infrastructure Models

Public Cloud



SME

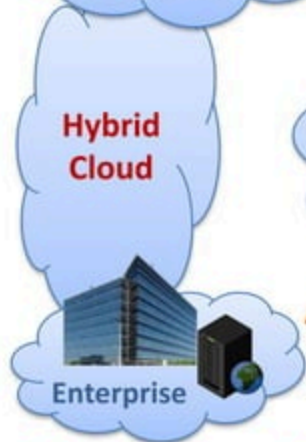


SME

Public Cloud



Hybrid Cloud



Private Cloud



SME



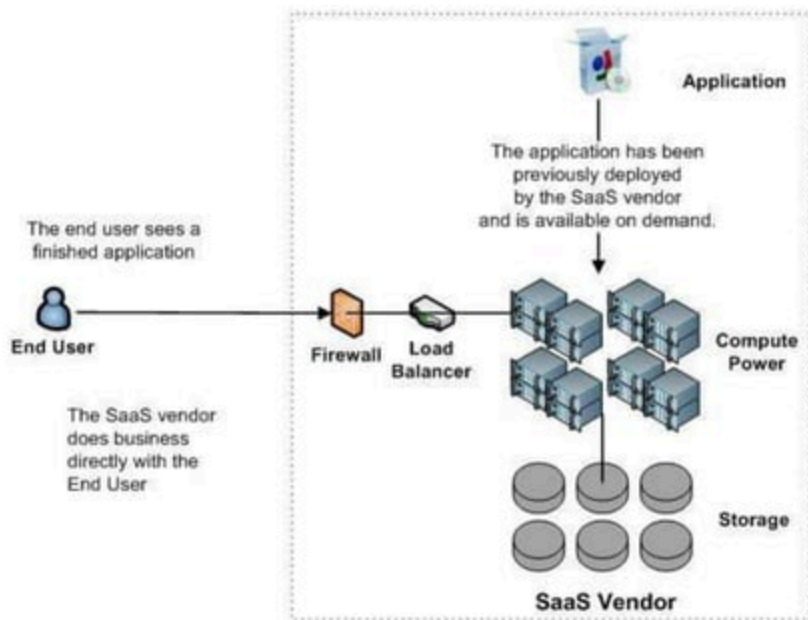
Private Cloud





Architectural Layers of Cloud Computing

Software as a Service (SaaS)



salesforce.com[®]
Success On Demand.

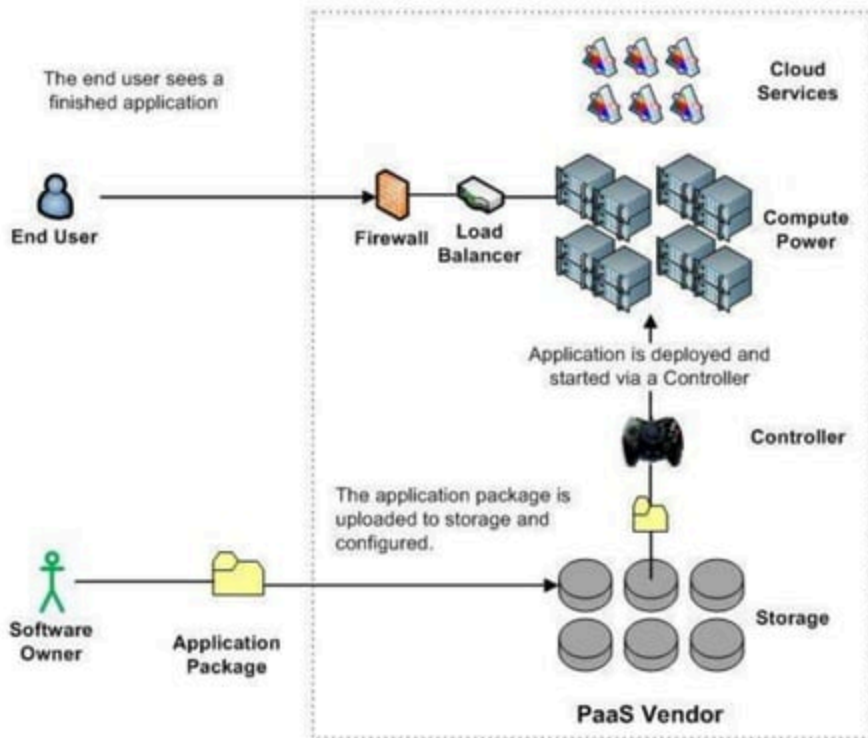
zoho[®]
Work. Online

sliderocket[®]

clarizen[®]
Projects Made Real

Google Docs

Platform as a Service (PaaS)



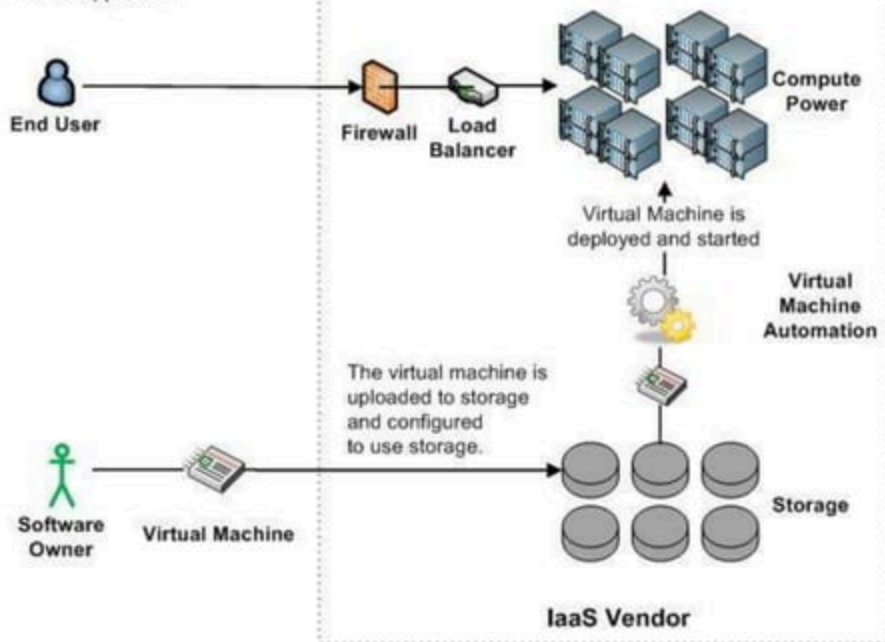
Google
App Engine



Windows Azure

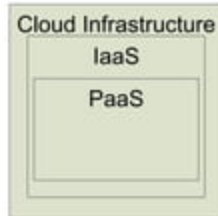
Infrastructure as a Service (IaaS)

The end user sees a finished application

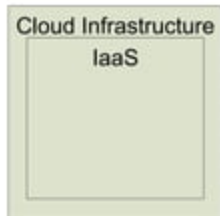




Software as a Service
(SaaS)
Architectures



Platform as a Service (PaaS)
Architectures



Infrastructure as a Service (IaaS)
Architectures

A photograph of a bright blue sky filled with large, puffy white cumulus clouds. The clouds are scattered across the frame, with some appearing closer and more detailed, while others are further away. The lighting is bright, suggesting a sunny day.

Cloud Computing Characteristics

Comparisons

Grid Computing

- A form of distributed computing
- A “super and virtual computer” is composed of a cluster of networked
- Loosely coupled computers acting in concert to perform very large tasks

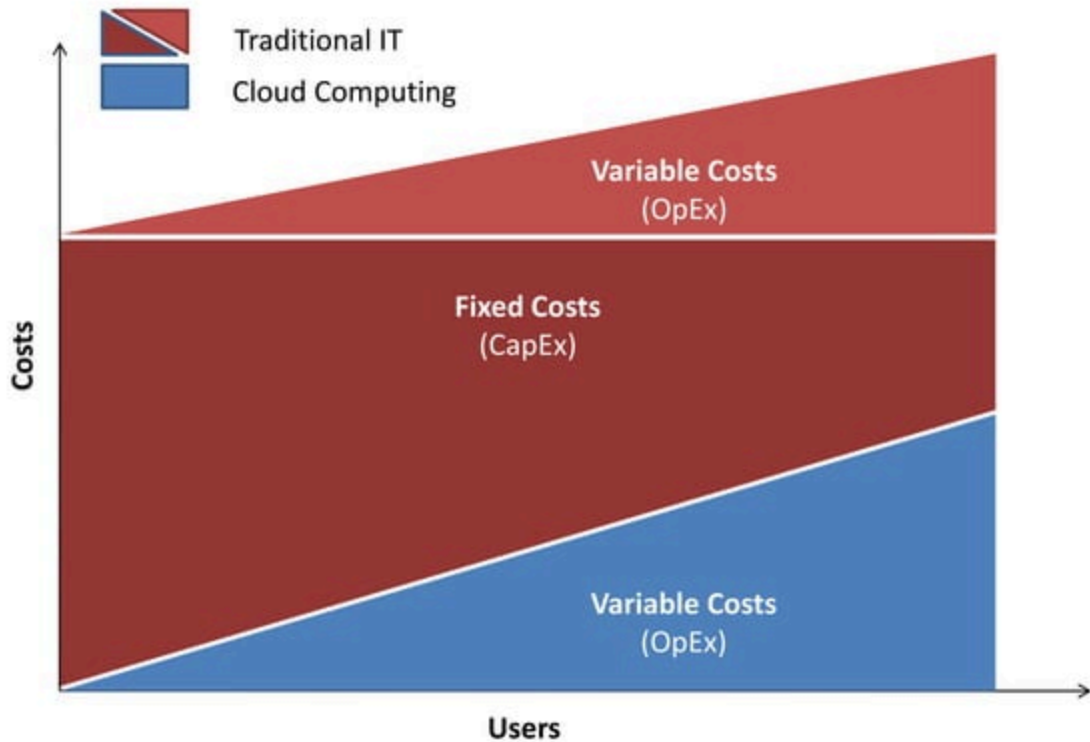
Utility Computing

- Packaging of computing resources, such as computation and storage
- A metered service similar to a traditional public utility, such as electricity

Autonomy Computing

- Computer systems capable of self-management

Cloud Computing Economics



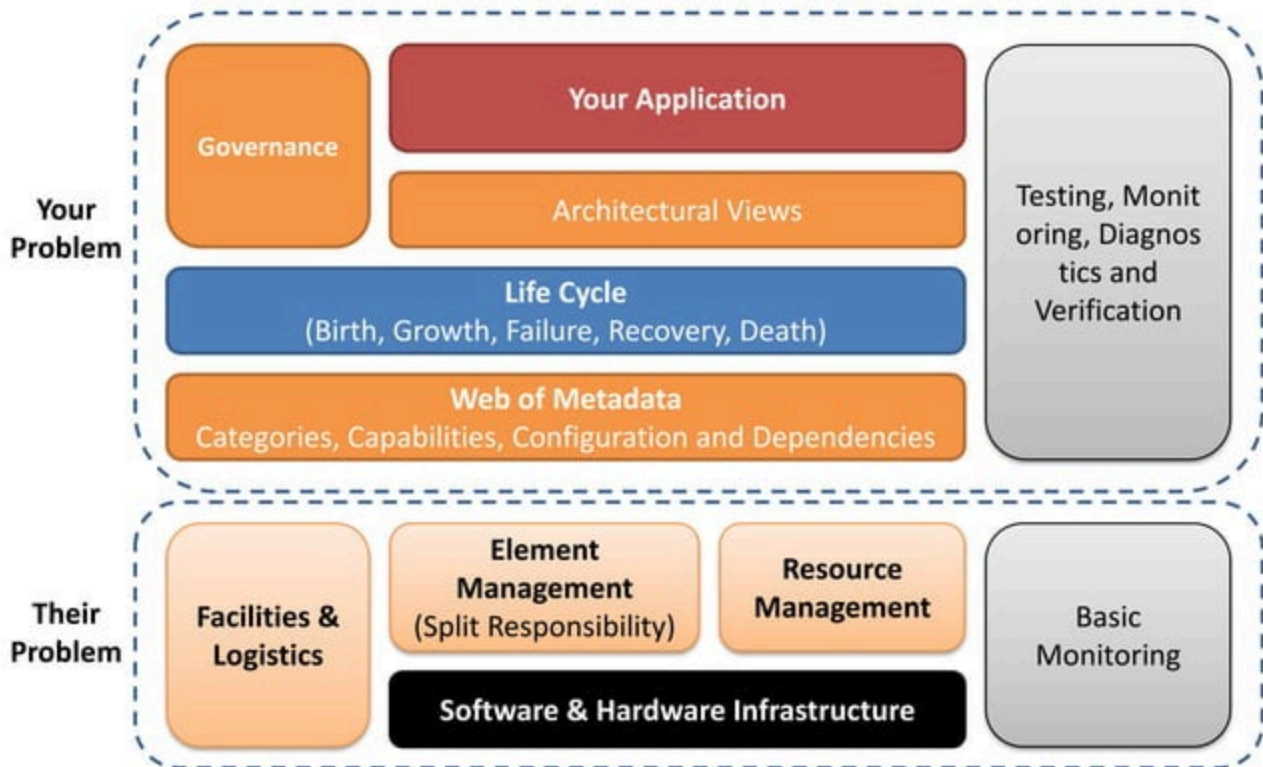
Pros and Cons



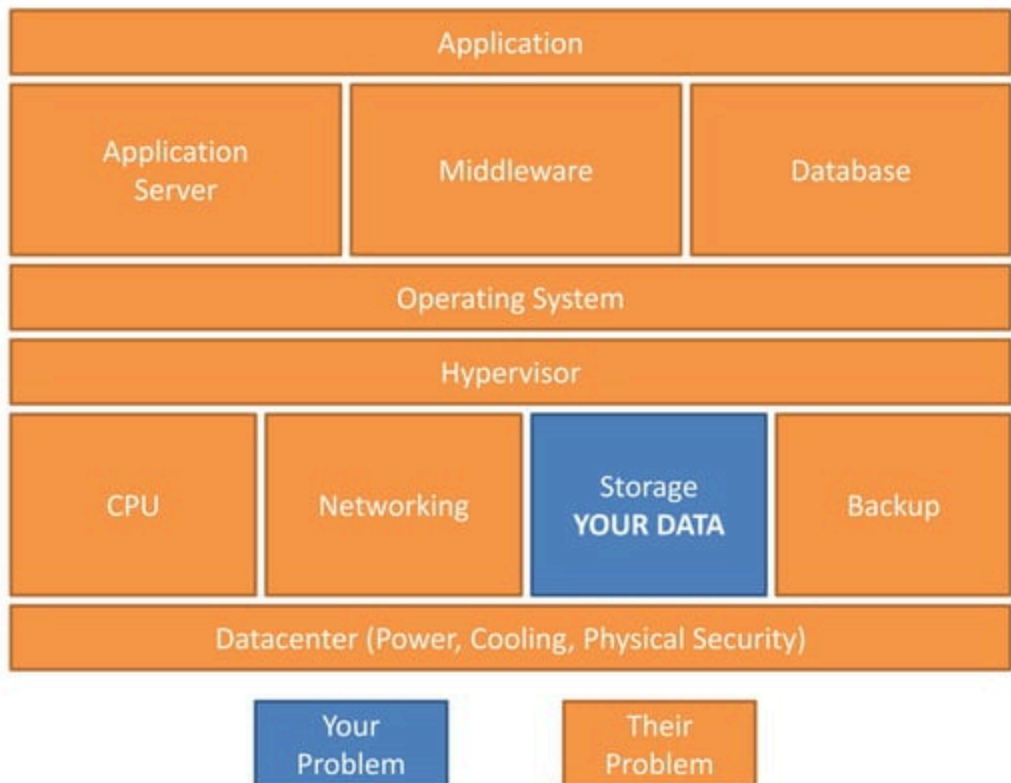


Cloud Computing Security

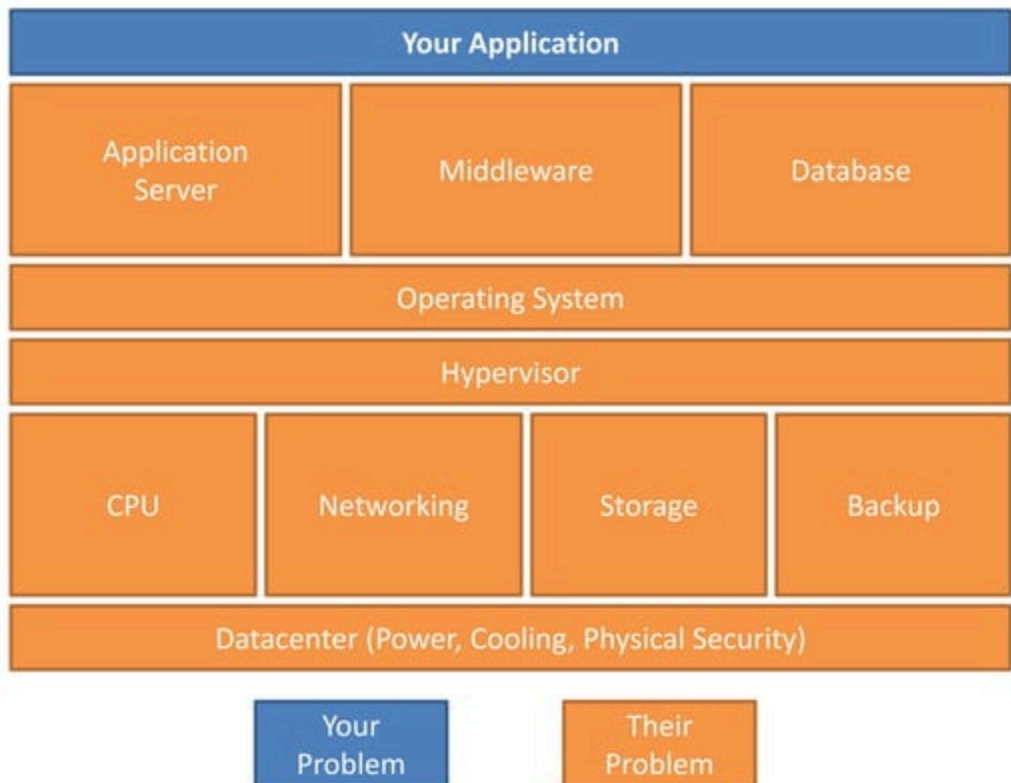
A Cloud Technology Reference Model



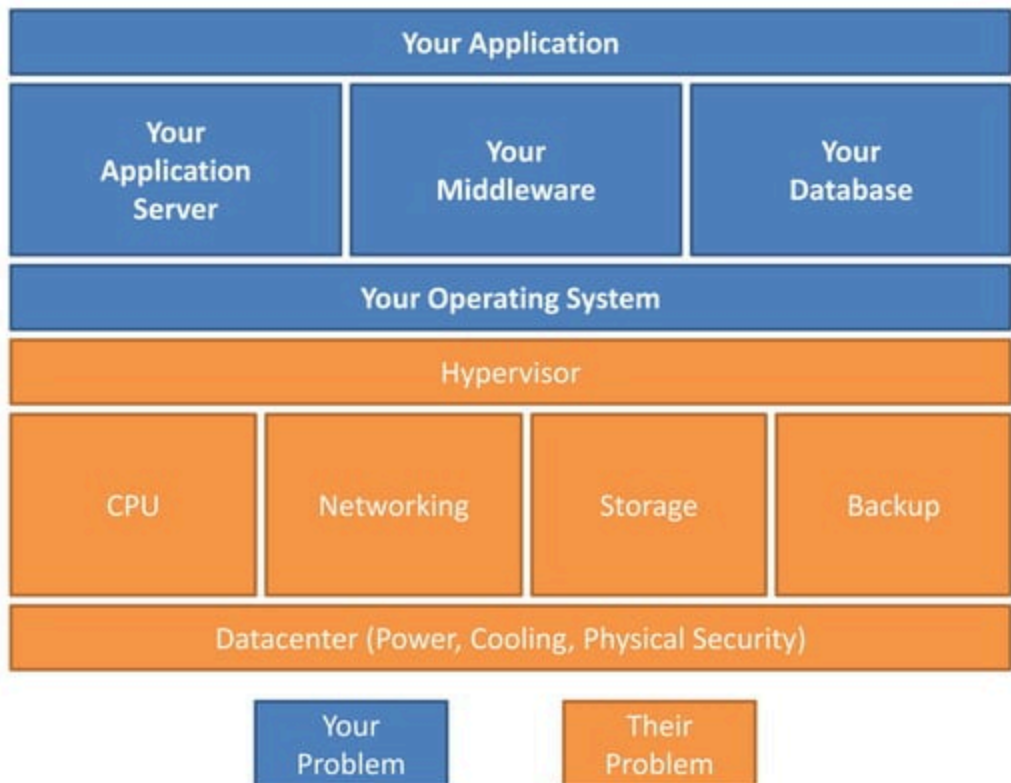
Software as a Service



Platform as a Service



Infrastructure as a Service





Security Issues

Overview

Governing in the Cloud

Governance & Enterprise Risk Management

Legal

Electronic Discovery

Compliance and Audit

Information Life Cycle Management

Portability & Interoperability

Operating in the Cloud

Traditional Security

Data Center Operations

Incident Response

Virtualization

Identity & Access Management

Storage

Application Security

Encryption & Key Management

Selected Issues

Governing in the Cloud

Governance & Enterprise Risk Management

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Information Life Cycle Management

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Encryption & Key Management

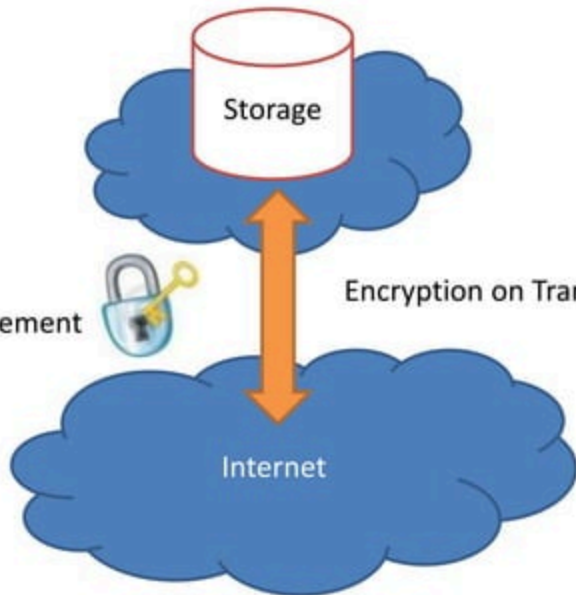
Computing As we know it...

www.khanacademy.com



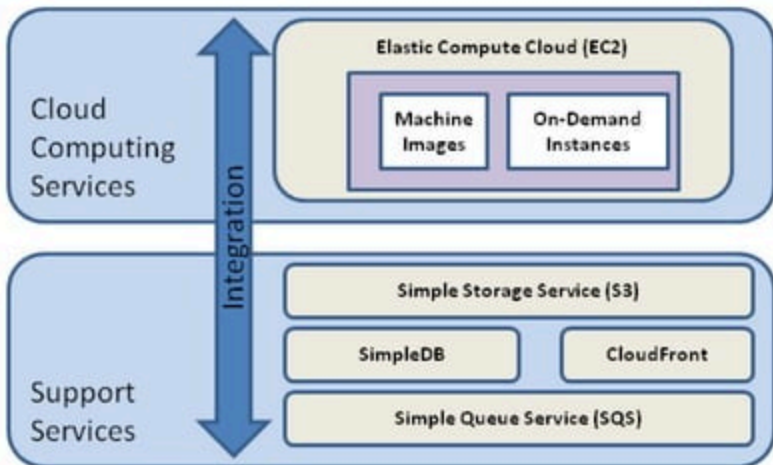
Encryption on Storage

Key Management



Case Study

Amazon Web Services (AWS)



AWS Registration and Security

Access Key ID and Secret Access Key

Access Key ID

Use your Access Key ID as the value of the `AWSAccessKeyId` parameter in requests you send to Amazon Web Services (when required). Your Access Key ID identifies you as the party responsible for the request.

Secret Access Key

Since your Access Key ID is not encrypted in requests to AWS, it could be discovered and used by anyone. Services that are not free require you to provide additional information, a request signature, to verify that a request containing your unique Access Key ID could only have come from you.

You use your Secret Access Key to calculate a signature to include in requests to web services that require authenticated requests. To learn more about request signatures, including when to use them and how you calculate them, please refer to the technical documentation for the specific web service(s) you are using.

Your Access Key ID:

BF0622QH9DHE7FKGBSH02

Your Secret Access Key:

[+ Show](#)

Generate a new Secret Access Key
(You will be asked to confirm this selection before a new Secret Access Key will be generated.)

[Generate](#)

X.509 Certificate

X.509 Certificate

Certificate File

An X.509 Certificate consists of Public Key and a Private Key. The file containing the public key, the certificate file, must contain a base64-encoded DER certificate body. The file containing the private key, the Private Key file, must contain a base64-encoded PKCS#8 private key. The Private Key is used to authenticate requests to AWS.

AWS accepts any syntactically and

Your X.509 Certificate:

Create New

Create a New X.509 Certificate

Download

Download Your X.509 Certificate

Upload

Upload Your Own X.509 Certificate

Delete

Delete Your Current X.509 Certificate from AWS

Multi-Factor Authentication



AWS Multi-Factor Authentication (AWS MFA)

Request Authentication with HMAC-SHA1 (1)

You

- 1 Create a request:

Request

AccessKeyId = ...
Action = ...
Timestamp = ...
ParameterA = ...

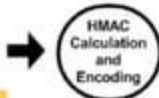
- 2 Create an HMAC-SHA1 signature:

String based on
request contents

+

Your Secret Access Key

kWorlUXSJEDGM/LImEEN//
aVmYvHNfSzB+d9+ct



Your Signature

- 3 Send the request and signature to AWS:

Request

AccessKeyId = ...
Action = ...
Timestamp = ...
ParameterA = ...

Your Signature

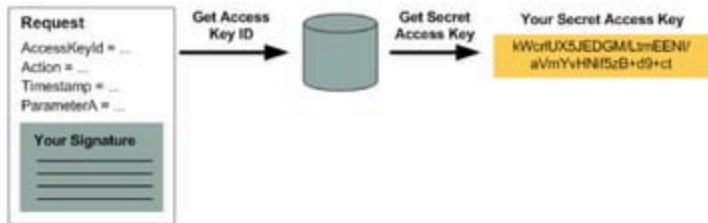


AWS

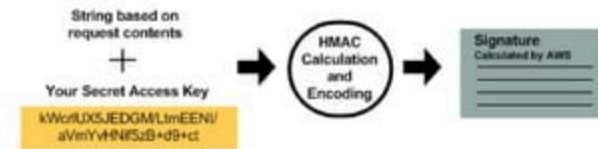
Request Authentication with HMAC-SHA1 (2)

AWS

- 4 Retrieve your Secret Access Key:



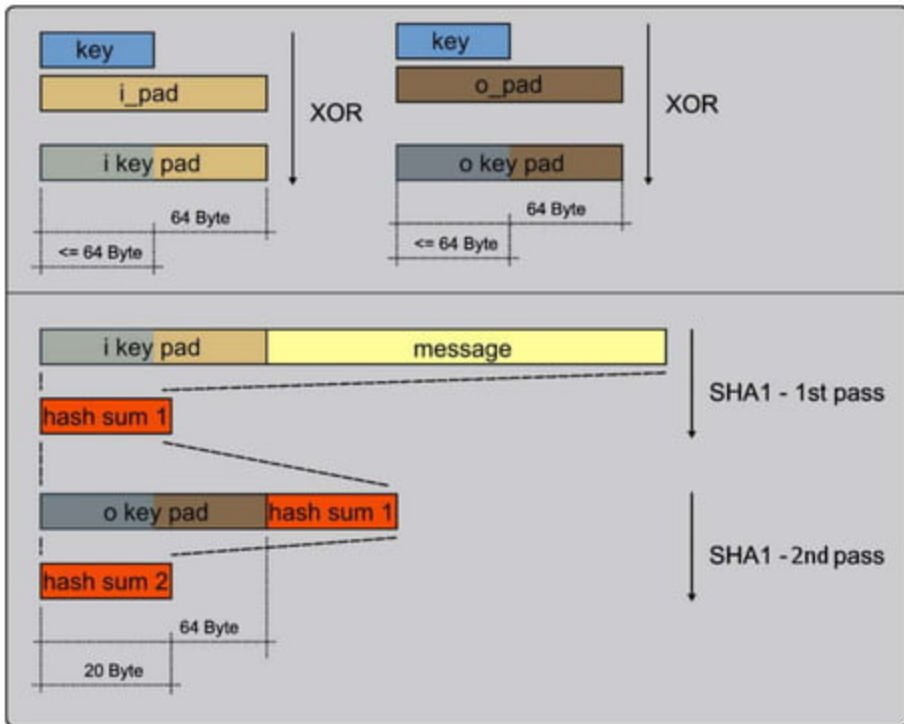
- 5 Create an HMAC-SHA1 signature:



- 6 Compare the two signatures:



HMAC-SHA1



Summary & Predictions

.. We think everyone on the planet deserves to have their own virtual data center in the cloud ..

- Lew Tucker

.. Cloud Computing Will Be As Influential As E-business ..

- Gartner

.. one of the most important transformations the federal government will go through in the next decade ..

- Obama's TIGR Team

.. Who knew that the concept of security in cloud computing was even possible to imagine?..

- Scott Bradner



Thank You