Cloud Computing

What is Cloud Computing?

Cloud Computing is a general term used to describe a new class of network based computing that takes place over the Internet, basically a step on from Utility Computing a collection/group of integrated and networked hardware, software and Internet infrastructure (called a platform).

Using the Internet for communication and transport provides hardware, software and networking services to clients These platforms hide the complexity and details of the underlying infrastructure from users and applications by providing very simple graphical interface or API (Applications Programming Interface).

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What is Cloud Computing

In addition, the platform provides on demand services, that are always on, anywhere, anytime and any place. Pay for use and as needed, elastic scale up and down in capacity and functionalities The hardware and software services are available to general public, enterprises, corporations and businesses markets

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Cloud computing is an umbrella term used to refer to Internet based development and services

A number of characteristics define cloud data, applications services and infrastructure:

Remotely hosted: Services or data are hosted on remote infrastructure. Ubiquitous: Services or data are available from anywhere.

Commodified: The result is a utility computing model similar to traditional that of traditional utilities, like gas and electricity - you pay for what you would want!

Many companies are delivering services from the cloud. Some notable examples include the following:

' Google — Has a private cloud that it uses for delivering Google Docs and many other services to its users, including email access, document applications, text translations, maps, web analytics, and much more.

' Microsoft — Has Microsoft@ Office 3650 online service that allows for content and business intelligence tools to be moved into the cloud, and Microsoft currently makes its office applications available in a cloud.

' Salesforce.com — Runs its application set for its customers in a cloud, and its Force.com and Vmforce.com products provide developers with platforms to build customized cloud services.

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Overview

- What is the cloud computing?

- History of Mobile Computing

- Service Models

- Deployment Models

- Architecture

- Security

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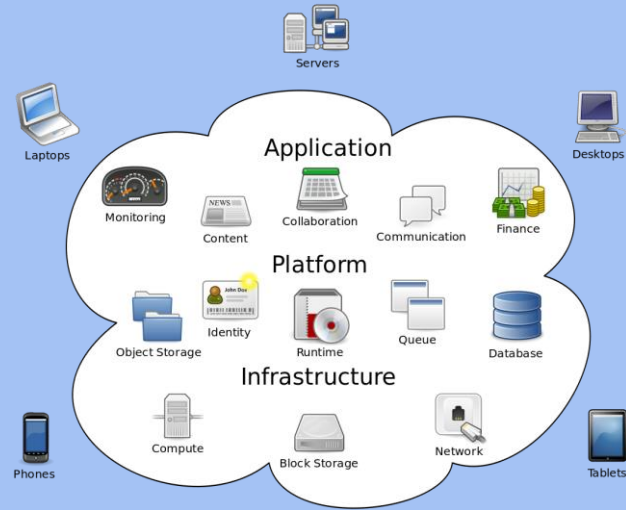
What is Cloud Computing?

Cloud computing:(noun)

Internet-based computing in which large groups of remote servers are networked so as to allow sharing of data-processing tasks, centralized data storage, and online access to computer services or resources.

Any computer related task that is done entirely on the Internet

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- Allows users to deal with the software without having the hardware.

- Everything is done by remote, nothing is saved locally.

Characteristics

- Empowerment

- Agility

- API

- Cost

- Device and location independence

- Visualization

- Multi-tenancy

- Reliability

- Scalability and Elasticity

- Security

- Maintenance

How Cloud Computing Works ©2008 HowStuffWorks

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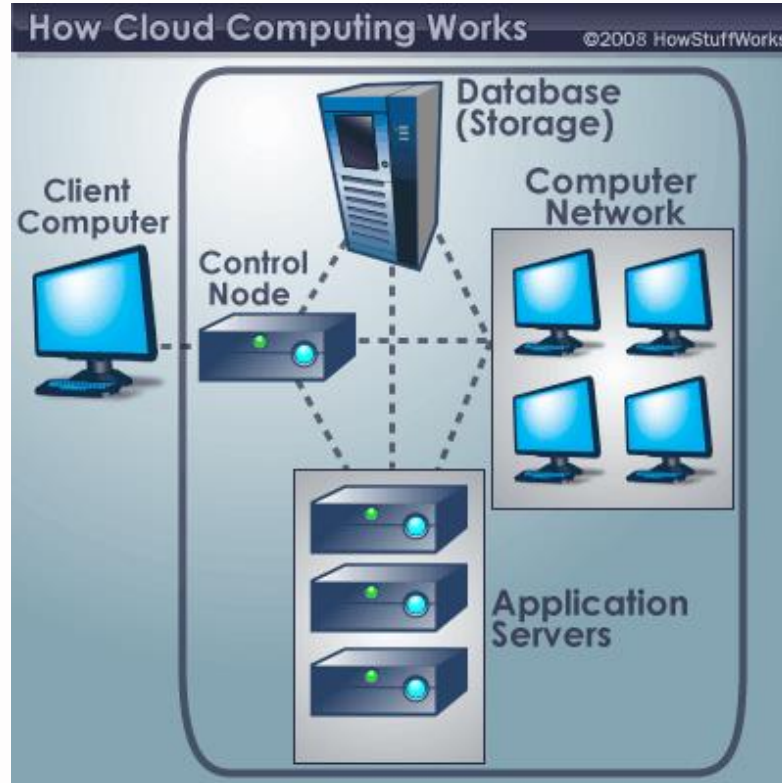
History

- 50's & 60's: theorized that the world would have cloud computing

- 90's: start of VPNs and efficient infrastructure

- 00's: Amazon builds efficient servers/ AWS

Service Models
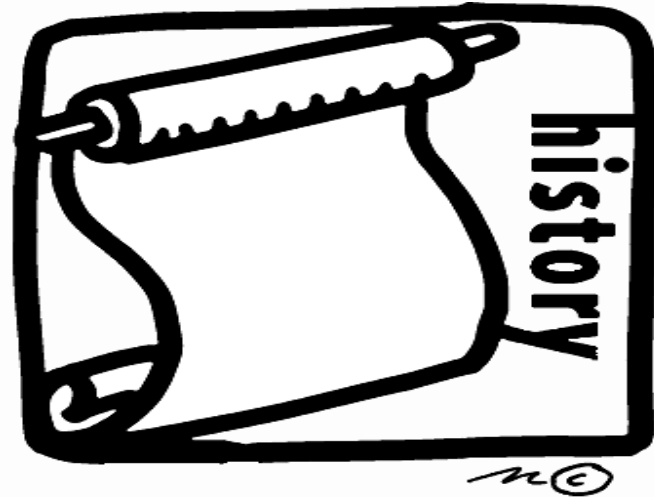
- Infrastructure as a Service (IaaS)

  - Basic, service users maintain software

- Platform as a Service (PaaS)

  - Users are given software and hardware automatically

- Software as a Service (SaaS)

  - All software and hardware is transparent

  - User only knows their own access point
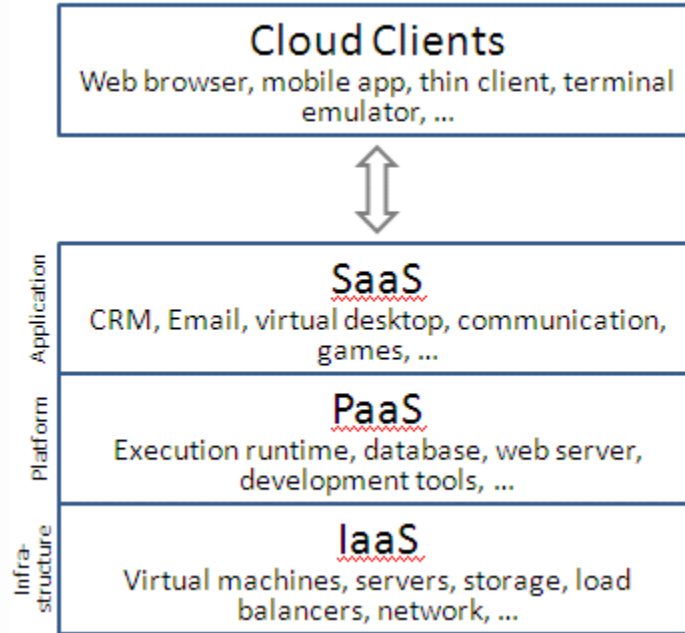
Deployment Models

- Public cloud

  - Done by service providers

- Community cloud

  - organizations from a specific community with common concerns

- Private cloud

  - operated solely for a single organization

- Hybrid cloud

  - composition of two or more clouds (private, community or public)

- Private Cloud Rentals

  - option to consider when security is a concern
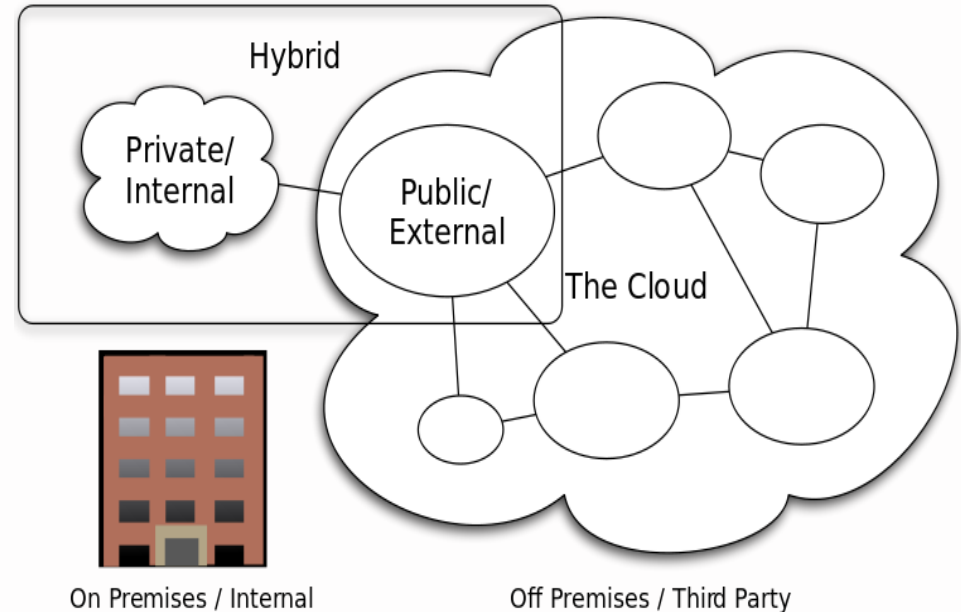
Architecture

- The software systems involved in the delivery, communicating over a loose coupling mechanism

- The Intercloud

  - The Intercloud is an interconnected global "cloud of clouds" and an extension of the Internet

- Cloud Engineering
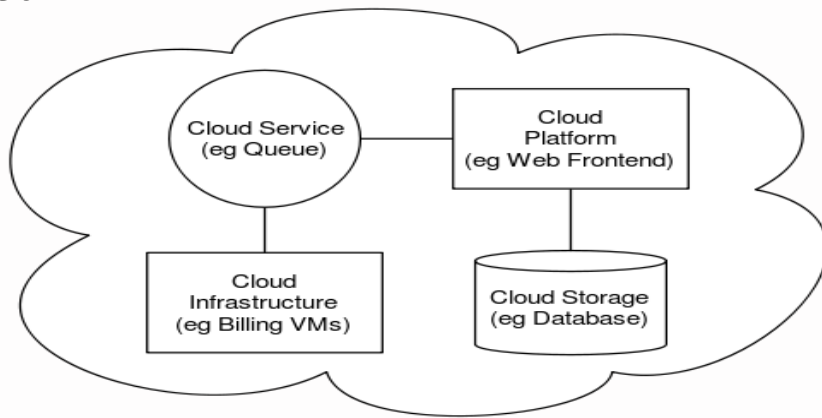
Cloud Engineering

- The application of engineering disciplines to cloud computing

- High level concerns

    - Commercialisation

    - Standardisation

- Governance in

    - Conceiving

    - Developing

    - Operating

    - maintaining

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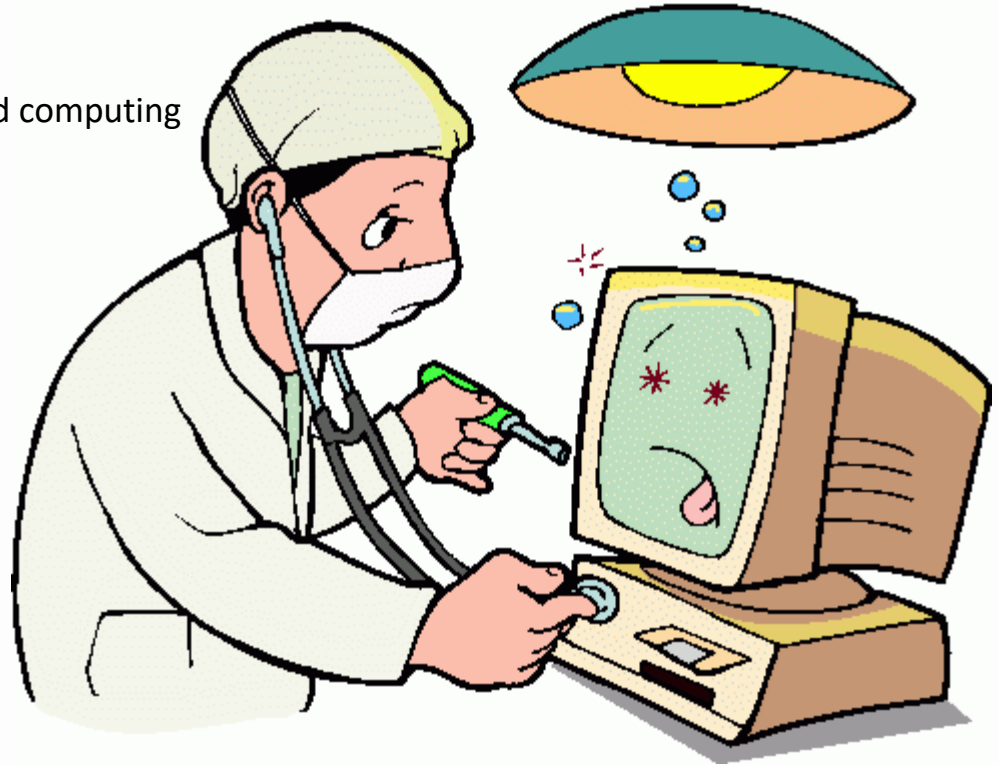
Security and Privacy

- Data protection

- Physical Control

- Identity management

- Physical and personnel security

- Availability

- Application security

- Privacy

- Legal issues

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Basic Concepts

There are certain services and models working behind the scene making the cloud computing feasible and accessible to end users.

Following are the working models for cloud computing:

1. Deployment Models

2. Service Models

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Deployment Models

Deployment models define the type of access to the cloud, i.e., how the cloud is located? Cloud can have any of the four types of access:

Public

Private

Hybrid

Community.

Deployment Models

PUBLIC CLOUD : The Public Cloud allows systems and services to be easily accessible to the general public. Public cloud may be less secure because of its openness, e.g., e-mail.

PRIVATE CLOUD : The Private Cloud allows systems and services to be accessible within an organization. It offers increased security because of its private nature.

COMMUNITY CLOUD : The Community Cloud allows systems and services to be accessible by group of organizations.

HYBRID CLOUD : The Hybrid Cloud is mixture of public and private cloud. However, the critical activities are performed using private cloud while the non- critical activities are performed using public cloud.

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Service Models

Service Models are the reference models on which the Cloud Computing is based. These can be categorized into three basic service models as listed below:

1. Infrastructure as a Service (IaaS)

2. Platform as a Service (PaaS)

3. Software as a Service (SaaS)

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Pizza as a Service

Traditional On-Premises (On Prem)	Infrastructure as a Service (IaaS)	Platform as a Service (PaaS)	Software as a Service (SaaS)
Dining Table	Dining Table	Dining Table	Dining Table
Soda	Soda	Soda	Soda
Electric / Gas	Electric / Gas	Electric / Gas	Electric / Gas
Oven	Oven	Oven	Oven
Fire	Fire	Fire	Fire
Pizza Dough	Pizza Dough	Pizza Dough	Pizza Dough
Tomato Sauce	Tomato Sauce	Tomato Sauce	Tomato Sauce
Toppings	Toppings	Toppings	Toppings
Cheese	Cheese	Cheese	Cheese
Made at home	**Take & Bake**	**Pizza Delivered**	**Dined Out**

■ You Manage   ■ Vendor Manages

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INFRASTRUCTURE PLATFORM (IaaS)	CONTAINER PLATFORM (CaaS)	APPLICATION PLATFORM (PaaS / aPaaS)	FUNCTION PLATFORM (FaaS)	SOFTWARE PLATFORM (SaaS)
OpenStack vSphere Azure Stack VMs	Kubernetes DC/OS Docker Datacenter	CloudFoundry OpenShift WaveMaker RAD	OpenWhisk Fission Iron.io	BYO
AWS EC2 GCE Azure VMs	GKE ECS ACS	Heroku PCF Jelastic	Lambda GCF Azure Functions	Salesforce Oracle SAP

HOSTED

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Infrastructure as a Service (IaaS)

IaaS is the delivery of technology infrastructure as an on demand scalable service. IaaS provides access to fundamental resources such as physical machines, virtual machines, virtual storage, etc.

'Usually billed based on usage

'Usually multi tenant virtualized environment

'Can be coupled with Managed Services for OS and application support

Best IaaS providers

- Amazon web services

- Google Cloud Platform

- Microsoft _Azure

- IBM Cloud

Platform as a Service (PaaS)

The runtime environment for applications, PaaS provides development & deployment tools, etc.

 PaaS provides all of the facilities required to support the complete life cycle of building and delivering web applications and services entirely from the Internet.

Typically applications must be developed with a particular platform in mind.

 'Multi tenant environments

'Highly scalable multi tier architecture

Top Paas Provider

salesforce

AWS Lambda

Morpheus

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Software as a Service (SaaS)

SaaS model allows to use software applications as a service to end users. SaaS is a software delivery methodology that provides licensed multi-tenant access to software and its functions remotely as a Web-based service.

' Usually billed based on usage

Usually multi tenant environment

Highly scalable architecture

Top Saas for Company

Microsoft Office 365

salesforce

Google Apps eox

Snowflake

Virtualization

Virtual workspaces: An abstraction of an execution environment that can be made dynamically available to authorized clients by using well-defined protocols, Resource quota (e.g. CPU, memory share), Software configuration (e.g. O/S, provided services). Implement on Virtual Machines (VMS): Abstraction of a physical host machine, Hvpervisor intercepts and emulates instructions from VMS, and allows management of VMS, Xen, etc. Provide infrastructure API: Plug-ins to hardware/support structures

Virtualization in General Advantages of virtual machines:

Run operating systems where the physical hardware is unavailable, Easier to create new machines, backup machines, etc.,

Software testing using "clean" installs of operating systems and software,

Emulate more machines than are physically available,

Timeshare lightly loaded systems on one host,

Debug problems (suspend and resume the problem machine),

Easy migration of virtual machines (shutdown needed or not).

Run legacy systems!

What is the purpose and benefits

Cloud computing enables companies and applications, which are system infrastructure dependent, to be infrastructure-less. By using the Cloud infrastructure on "pay as used and on demand", all of us can save in capital and operational investment!
Clients can: Put their data on the platform instead of on their own desktop PCs and/or on their own servers. They can put their applications on the cloud and use the servers within the cloud to do processing and data manipulations etc.

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Cloud-Sourcing

Why is it becoming a Big Deal: Using high-scale/low-cost providers, Any time/place access via web browser, Rapid scalability; incremental cost and load sharing,

Can forget need to focus on local IT.

Concerns: Performance, reliability, and SLAs, Control of data, and service parameters, Application features and choices, Interaction between Cloud providers,

No standard API - mix of SOAP and REST! Privacy, security, compliance, trust...

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Opportunities and Challenges

The use of the cloud provides a number of opportunities: It enables services to be used without any understanding of their infrastructure. Cloud computing works using economies of scale: It potentially lowers the outlay expense for start up companies, as they would no longer need to buy their own software or servers. Cost would be by on-demand pricing. Vendors and Service providers claim costs by establishing an ongoing revenue stream. Data and services are stored remotely but accessible from "anywhere".

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Opportunities and Challenges

In parallel there has been backlash against cloud computing: Use of cloud computing means dependence on others and that could possibly limit flexibility and innovation: The others are likely become the bigger Internet companies like Google and IBM, who may monopolise the market. Some argue that this use of supercomputers is a return to the time of mainframe computing that the PC was a reaction against. Security could prove to be a big issue: It is still unclear how safe out-sourced data is and when using these services ownership of data is not always clear.

Opportunities and Challenges

There are also issues relating to policy and access: If your data is stored abroad whose policy do you adhere to? What happens if the remote server goes down?

How will you then access files?

There have been cases of users being locked out of accounts and losing access to data

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Disadvantages of Cloud Computing

Requires a constant Internet connection: Cloud computing is impossible if you cannot connect to the Internet. Since you use the Internet to connect to both your applications and documents, if you do not have an Internet connection you cannot access anything, even your own documents. A dead Internet connection means no work and in areas where Internet connections are few or inherently unreliable, this could be a deal-breaker.

Virtualization

Virtualization Layer

APPLICATION-01	APPLICATION-02	APPLICATION-03
GUEST OS-01	GUEST OS-02	GUEST OS-03
VIRTUAL HARDWARE	VIRTUAL HARDWARE	VIRTUAL HARDWARE

HYPERVISIOR(Hyper-V,Xen)

Host Operating System

Infrastrcture-CPU,Memory,HDD
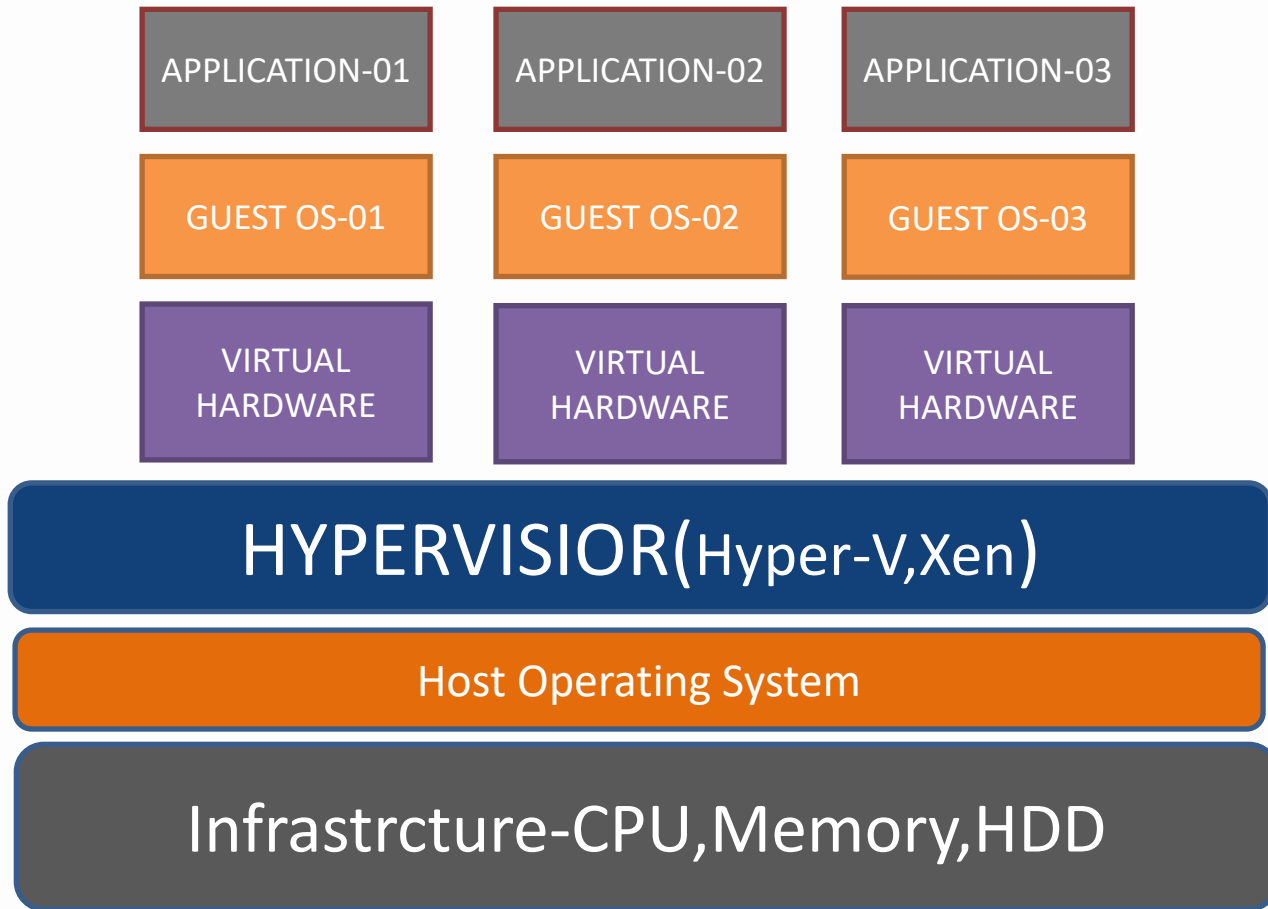
Virtualization

Virtualization

- Virtualization gives the ability to run multiple operating system on a single physical system and share the underlying hardware resource

Hypervisor

- Hypervisor is called virtual machine monitor , allows multiple OS to run concurrently on a host computer, a feature called hardware virtualization
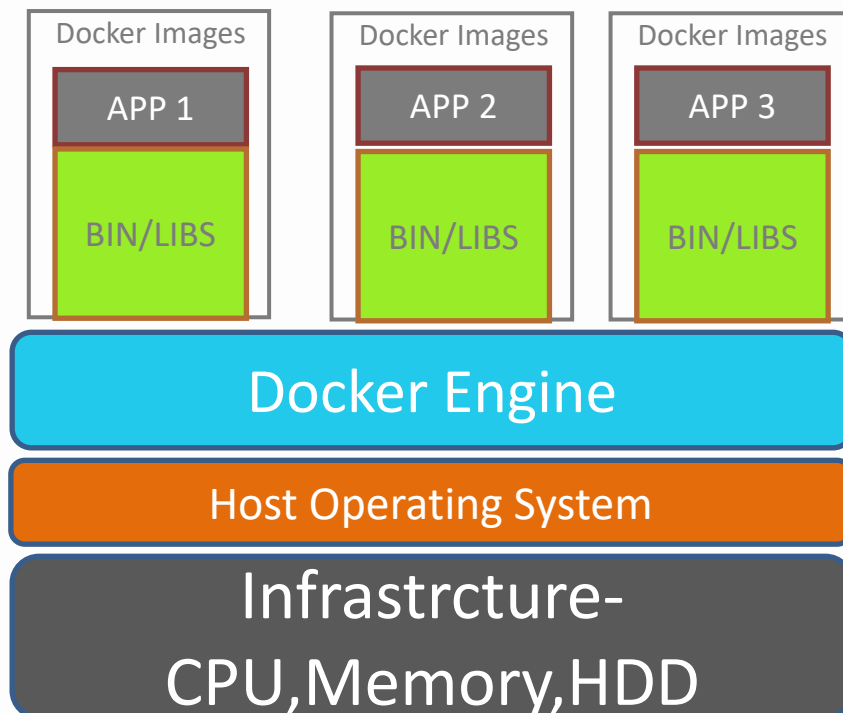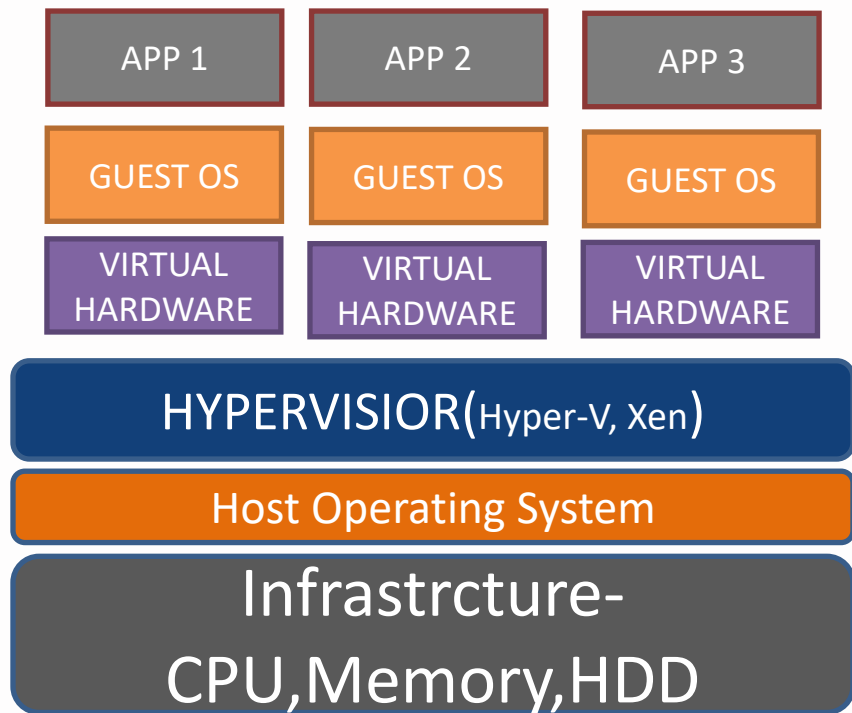
Host Machine

- A Computer on which a hypervisor runs allowing you to create VMs, termed as Host machines

Guest Machine

- Using the Hypervisor over installed host machine, you can create instance /virtual machines ,called a guest machine

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What is Docker

Basics of Networking-I

IP address and Classes

IP address are used for naming your devices in a network/a network itself

- Fundamentals of data –Bits and Bytes

- Bits   --   0 and 1

- 8 bits   --   1 byte (N-an Octets)

Types of IP Addresses

- IPV4   --   32 bit

- IPv6   --   128 bit

- 2^0 1
- 2^1
                2
- 2^2
                4
- 2^3
                8
- 2^4
                16
- 2^5
                32
- 2^6
                64
- 2^7
                128

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IP addressing

- To derive,

- Min IP address – use 0 for all bits (expect Parity bit)

- Max IP address – use 1 for all bits (expect Parity bit)

- No.of Networks ===> 2^(N-P)   //N – No. of network bits,P-Parity Bit

- No.of Hosts   ===> (2^H)   //H-No.of host bits

- No.of Valid Ips ===> (2^H) -2   //H-No.of host bits

- When calculating hosts' IP addresses, 2 IP addresses are reserved-Network ID & Broadcast ID

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Class for IP Addresses

CLASS-A

Class	Parity Bit Range		Format
A	0	(0.0.0.0 -- 127.255.255.255)	N.H.H.H

Range :

                P   P

0|11111111.11111111.11111111.11111111   0|00000000.00000000.00000000.00000000   ----

                                                                         (0.0.0.0 -- 127.255.255.255)

No.of Networks ==> $2^{(N-P)}$ == > $2^{(8-1)}$ => 2^7
     = 128

No.of Hosts ==> 2^H ==> 2^{24}
                 = 16777216

No.of Valid Ips ==> $(2^H)-2$ ==> $(2^{24})-2$ =
     16777214 IPs/Network

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CLASS-B

Class	Parity Bit	Format	Range	
B	10		N.N.H.H	(128.0.0.0--
191.255.255.255)				

Range :

<pre>
                                    P
                                    P
                         10|000000.00000000.00000000.00000000   --
       10|111111.11111111.11111111.11111111
                           (128.0.0.0-- 191.255.255.255)
</pre>

No.of Networks ==>		$2^{(N-P)}$	==>	$2^{(8+8-2)}$ =>
2) =>	$2^{14} = 16384$			
No.of Hosts ==>		2^H	==>	$2^{(8+8)}$
=>	$2^{16} = 65536$			
No.of Valid Ips ==>		$(2^H)-2$	==>	$(2^{16})-2$ =>	65534
IPs/Network				

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CLASS-C

Class	Parity Bit	Format	Range	
C	110		N.N.N.H	(192.0.0.0-- 223.255.255.255)

Range :

$$110|11111.11111111.11111111.11111111$$

(P)

P

$$110|00000.00000000.00000000.00000000$$ ----

(192.0.0.0-- 223.255.255.255)

No.of Networks ==> 2097152 $2^{(N-P)}$ ==> $2^{(8+8+8-3)}$=>2^{21} =>

No.of Hosts ==> 2^H==> $2^{(8)}$=256

No.of Valid Ips ==> $(2^H)-2$ ==> $(2^8)-2$ =256 -2 =>254 IPs/Network

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Summary of IP Addressing Classes

CLASS	CLASS-RANGE	OCTET FORMAT	IPs/Network
A	0.0.0.0-- 127.255.255.255	N.H.H.H	16777214 IPs/Network
B	128.0.0.0-- 191.255.255.255	N.N.H.H	65534 IPs/Network
C	192.0.0.0-- 223.255.255.255	N.N.N.H	254 IPs/Network

Private Address

There are certain addresses in each class of IP address that are reserved for Private Networks, called Private Addresses

Range of Private IP address
- Class-A   10.0.0.0 - 10.255.255.255
- Class-B   172.16.0.0 -172.31.255.255
- Class-C   192.168.0.0 - 192.168.255.255

Private Vs Public Addresses

PRIVATE IP ADDRESS	PUBLIC IP ADDRESS
Used within an Organization	Used over Public Network
Internet can't resolve this address	Recognized over Internet
Administrator assigns	By service provider (IANA)
Free	Charges by Service Provider
Unregistered IP	Registered

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Subnetting

SUBNETTING

- Process of dividing a single network into multiple smaller networks. (Grouping of IPs)
- By Subnetting, we can minimize the wastage of IPs

SUBNET MASK

- It's an address which is used to identify the Network and Host portion of IP

Ex: 10.0.0.0/8.8.0.0 or 255.255.0.0 or /16

     172.31.0.0/16 or 172.31.1.0/24

Tip:

How to calculate No of valid Ips for a network 10.0.0.0/24,?

Total number of Bits (for IPv4) =32

$\Rightarrow$ Total of Bits (32)- Subnet Mask   ==>   (32 -24) = 8

$\Rightarrow$ (2^8)-2= 254

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Scenario-I

Given Network(N)　　　　------>　　　　172.31.0.0/16

Requirement　　　　-------->　　　　N1----500

Req=== 500

Sol

No. of instances ==> No. of Ips===> Valid Ips===(2^H)-2

(2^H)-2==500

H=8,...2^8==256

H=9,....2^9=512

IPv4===32 Bits (N+H=32)

H=9,...N=32-H=32-9=23

N=23===> 8.8.7 = 255.255.254.0

N1(500)===> 172.31.254.0/23

Scenario-II

Given Network(N)　　　　------>　　　　172.31.0.0/16

Requirement　　　　-------->　　　N1----100

Req=== 100

Sol

No. of instances ==> No. of Ips===> Valid Ips===(2^H)-2

(2^H)-2==100

H=6,...2^6==64

H=9,....2^7=128

IPv4===32 Bits (N+H=32)

H=7,...N=32-H=32-7=25

N=23===> 8.8.8.1 = 255.255.255.128

N1(100)===> 172.31.0.128/25

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NAT

- NAT stands for as Network Address Translation

- NATTING is method of "Translation of Private IP address into Public address"

  Ex: 52.31.100.200 (PublicIP)<--------->NAT(network Address Translator)<----------->PrivateIP(10.0.1.201)

- Public IP address is required to communicate with Internet

- Public subnets are Internet facing subnets

- Private subnets are non internet facing subnets

- NAT Servers are to be launched in Public Subnet

- By launching NAT servers, we make private subnets servers do get Internet access

  NOTE: You should Disable Source/Destination check point on NAT

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Understanding JSON

What is JSON

- JSON - JavaScript Object Notation

- Light weighted syntax

- Used for exchanging data that

- Designed to be understood easily by humans, and parsed easily by machines

- JSON is based on the JavaScript scripting language

- However, JSON itself is completely language independent

- JSON have a .json extension

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Structure for JSON

- JSON is defined by two basic structures.
    - Name/value pairs
    - Ordered list of values
- A value can be any one of the following types, and these structures can be nested:
    - String (Unicode)
    - Number
    - Boolean (true or false)
    - Array
    - Object
    - null (empty)

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Key-Value Pairs

- {

  "name" : "Peter", "location": "Ohio", "member": "false"

  }

- {

  "name" : "Williams",

  "location": "Oregon",

  "member":"True"

  }

name	location	member
Peter	Ohio	false
Williams	Oregon	True

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Arrays

Arrays contain a list of values, which can be of any type

Example:

This object has two arrays;

```
{
            "ID": [5, 10, 15, 20],
            "names": ["John", "Elizabeth", "Mary"]
}
```

Another Example

Tool page   :   http://jsonviewer.stack.hu/

Data:

{ "firstName": "John", "lastName": "Smith", "birthday": "1975-01-31", "spouse": {   "firstName": "Mary",   "lastName": "Smith" }, "addresses": [{   "description": "home",   "street": "123 Peachtree Ln",   "city": "Atlanta",   "state": "GA",   "postalCode": 30305 },   {   "description": "work",   "street": "456 Peachtree St",   "city": "Atlanta",   "state": "GA",   "postalCode": 30305   }], "phoneNumbers": [{   "description": "home",   "number": "404-555-1234"   },   {   "description": "mobile",   "number": "678-555-1234"   }]}

Understanding YAML

What is YAML

- YAML – Yet another markup language

- YAML Ain't Markup Language

- YAML is a human friendly data serialization standard for all programming languages

- .YML extension to be used for YAML files

- Though YAML syntax may seem daunting and terse at first, there are only three very

  simple rules to remember when writing YAML

RULES for YAML

- **Rule One:** *Indentation*

- **Rule Two:** *Colons*

- **Rule Three:** *Dashes*

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RULES - Indentation

- Indentation for each level consists of exactly two spaces

- Do not use tabs

Ex:

Name: Arjun

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RULES-Colons

- Dictionary keys are represented in YAML as strings terminated by a trailing colon

- Values are represented by either a string following the colon, separated by a space

- *In YAML,*

  Name:

   Anandh

  Name:

   FirstName: Anandh

   LastName: Kumar

RULES- Dashes

To represent lists of items, a single dash followed by a space is used

Multiple items are a part of the same list as a function of their having the same level of indentation

Ex:

- Brands:
  - ASICS
  - Skechers
  - Tuscon

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Introduction to VPC

172.31.0.0/16

VPC

Availability Zone-2a

Availability Zone-2b

172.31.1.0/24

2a-PublicSubnet

Web App Server

172.16.0.0
172.16.1.0
172.16.2.0

172.31.2.0/24

DB-Master

2a-PrivateSubnet

DBServer-Primary

172.31.3.0/24

2b-PublicSubnet

Web App Server

172.16.0.0
172.16.1.0
172.16.2.0

172.31.4.0/24

DB-Slave

2b-PrivateSubnet

DBServer- Secondary

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Security Groups and NACL

172.31.0.0/16

VPC

172.31.1.0/24

PublicNACL

WebServer SG

Web App Server

2a-PublicSubnet

172.31.2.0/24

DB Master

DB Server

2a-PrivateSubnet

PrivateNACL

DBSecurityG

172.31.3.0/24

Web App Server

2b-PublicSubnet

172.31.4.0/24

DB Slave

2b-PrivateSubnet

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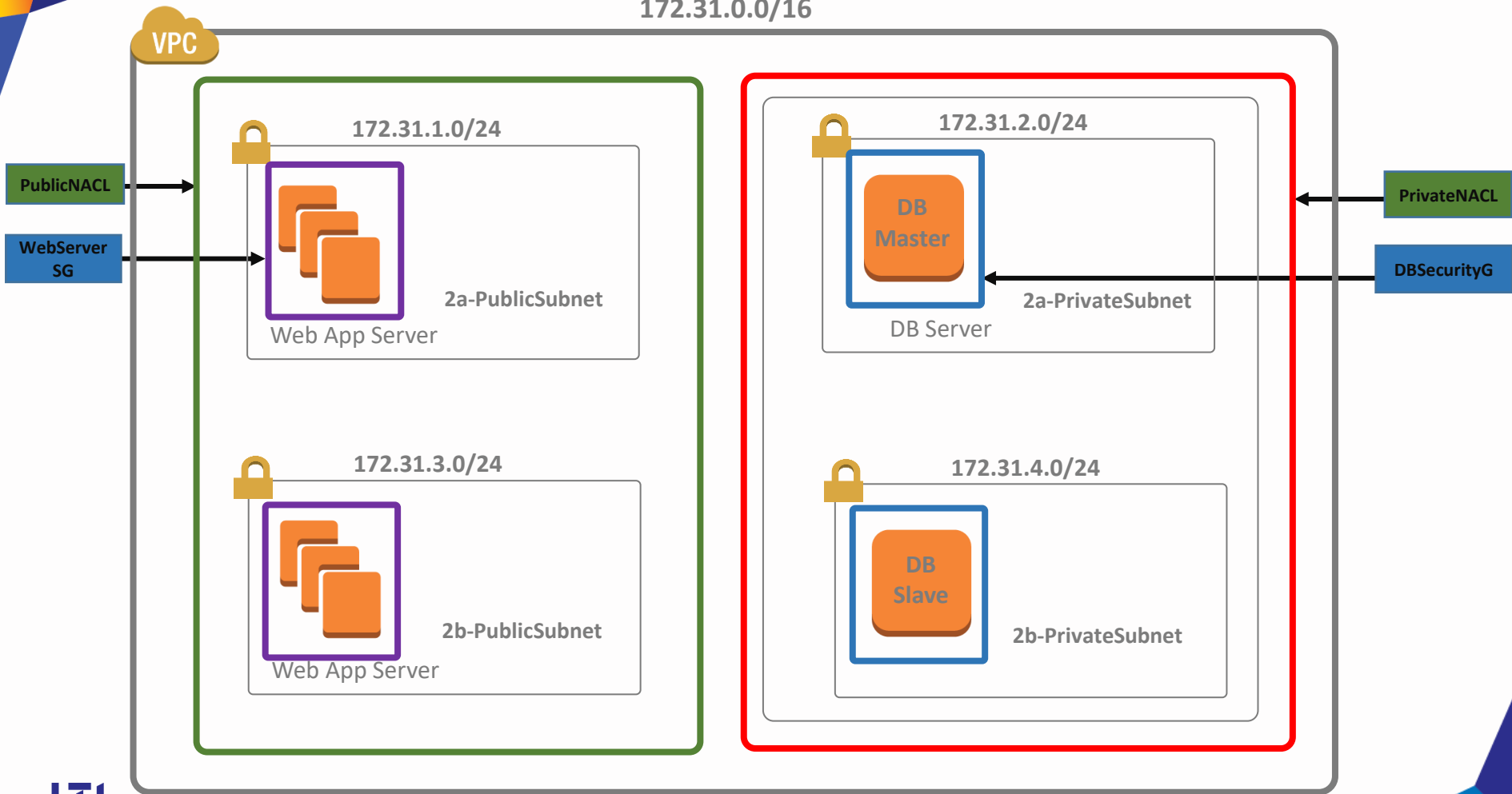
Network Access Control List (NACL)

172.31.0.0/16

VPC

PublicNACL

PrivateNACL

172.31.1.0/24

2a-PublicSubnet

Web App Server

172.31.2.0/24

2a-PrivateSubnet

DB Master

DB Server

HTTP 80

SSH 22

172.31.3.0/24

2b-PublicSubnet

Web App Server

172.31.4.0/24

DB Slave

2b-PrivateSubnet

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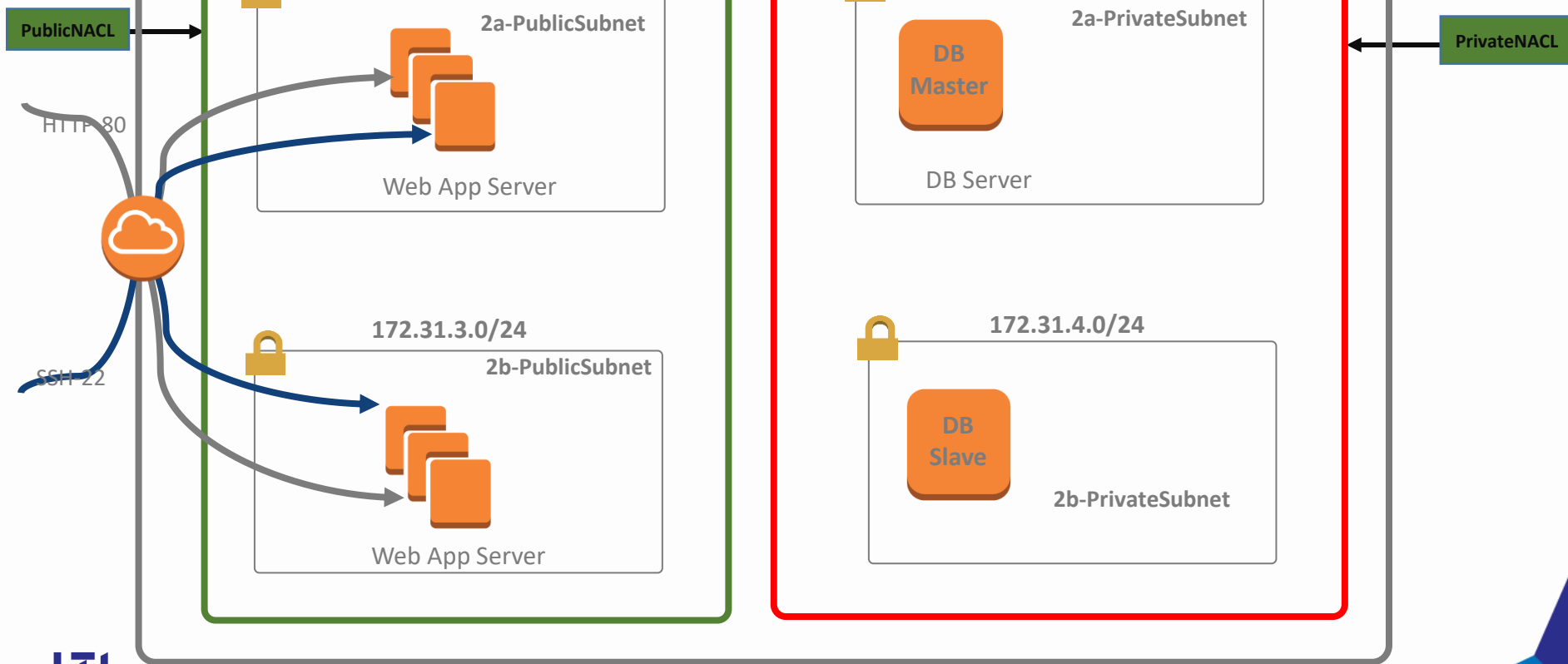
Security Groups (SG)
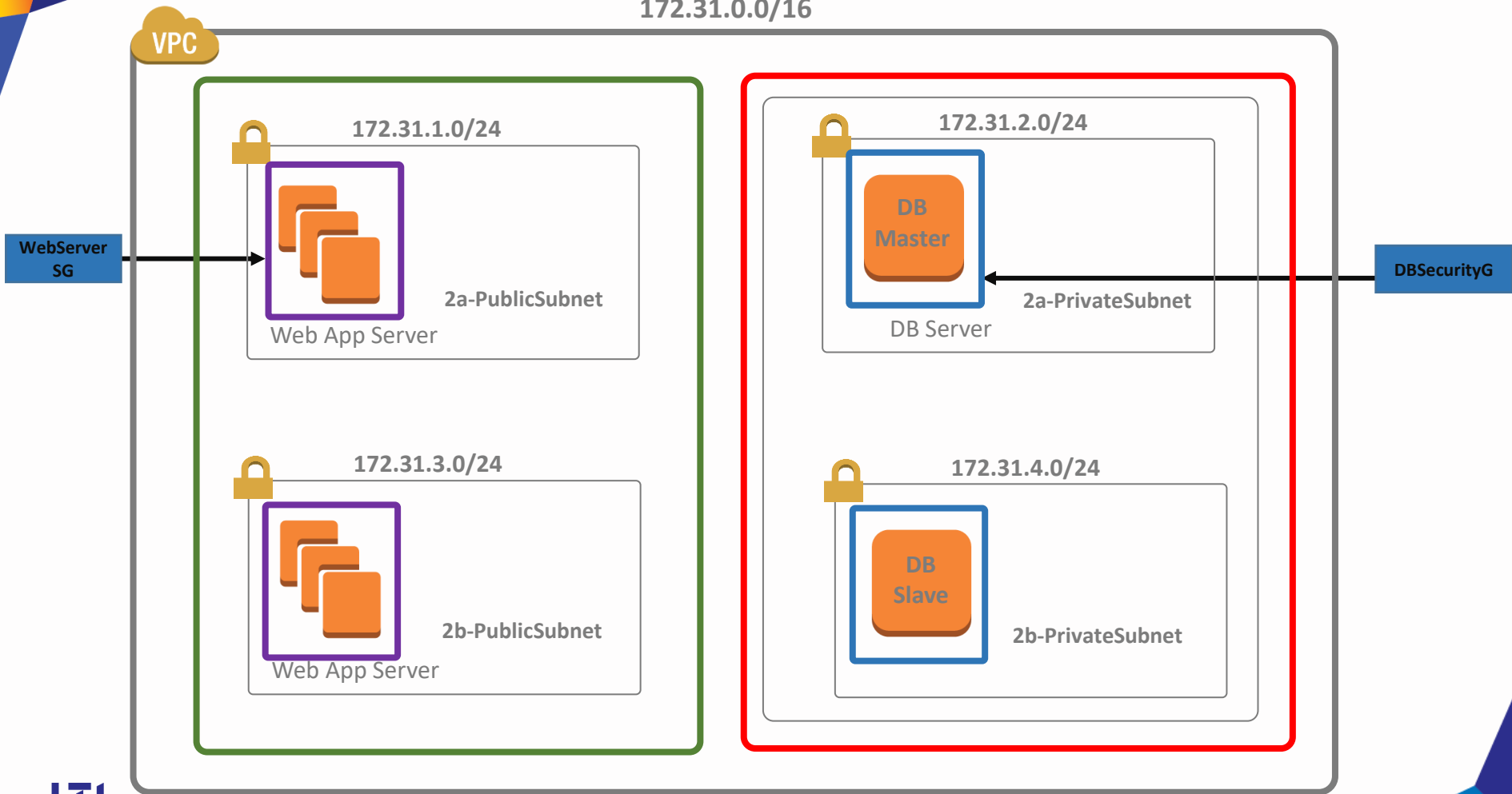
NAT Gateway
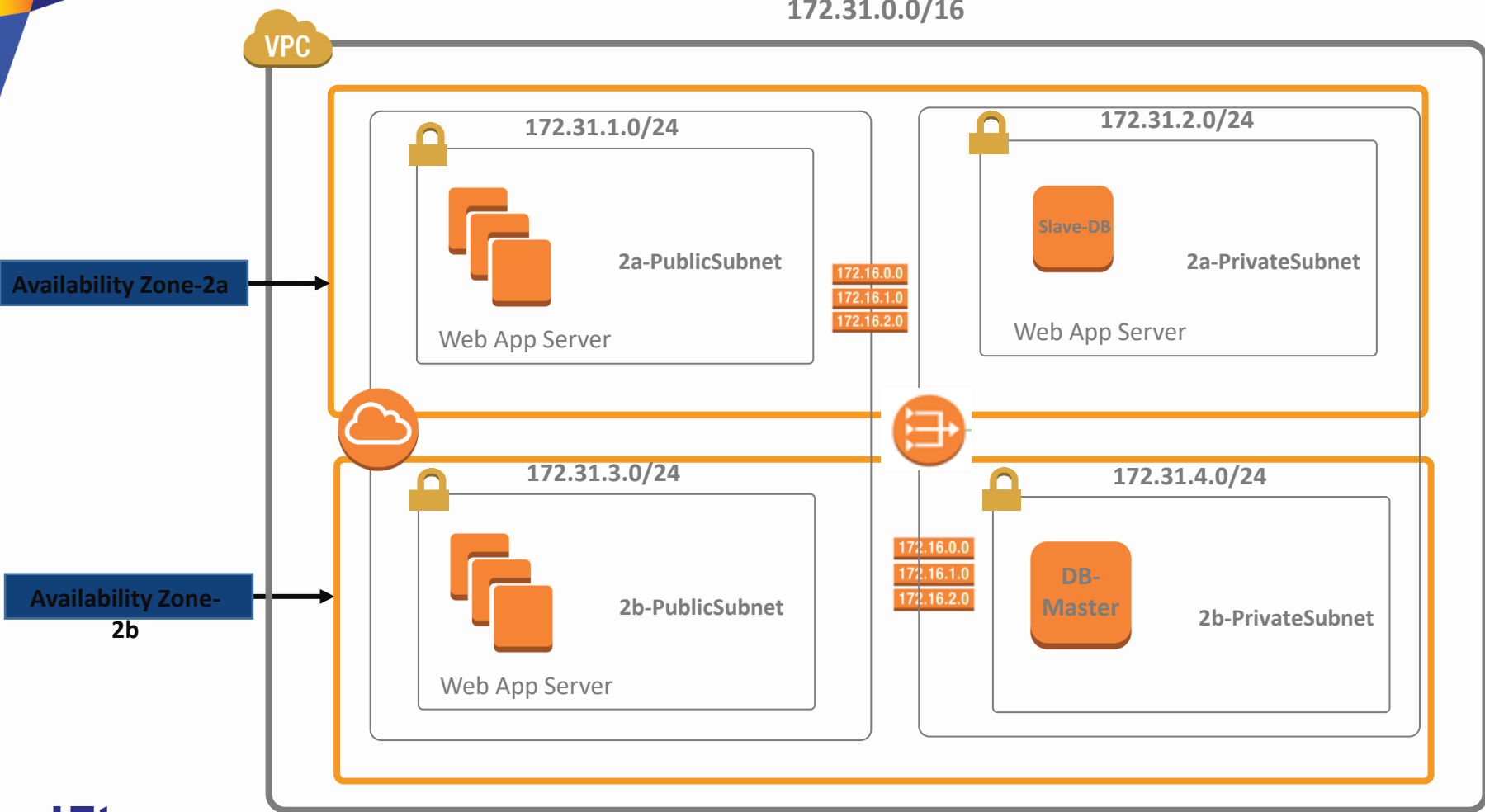
Enabling Technologies

Cloud applications: data-intensive, compute-intensive storage-intensive

Bandwidth

WS

Services interface

Web-services, SOA, WS standards

VM0   VM1   VMn

Virtualization: bare metal, hypervisor. …

Multi-core architectures

Storage Models: S3, BigTable, BlobStore, …

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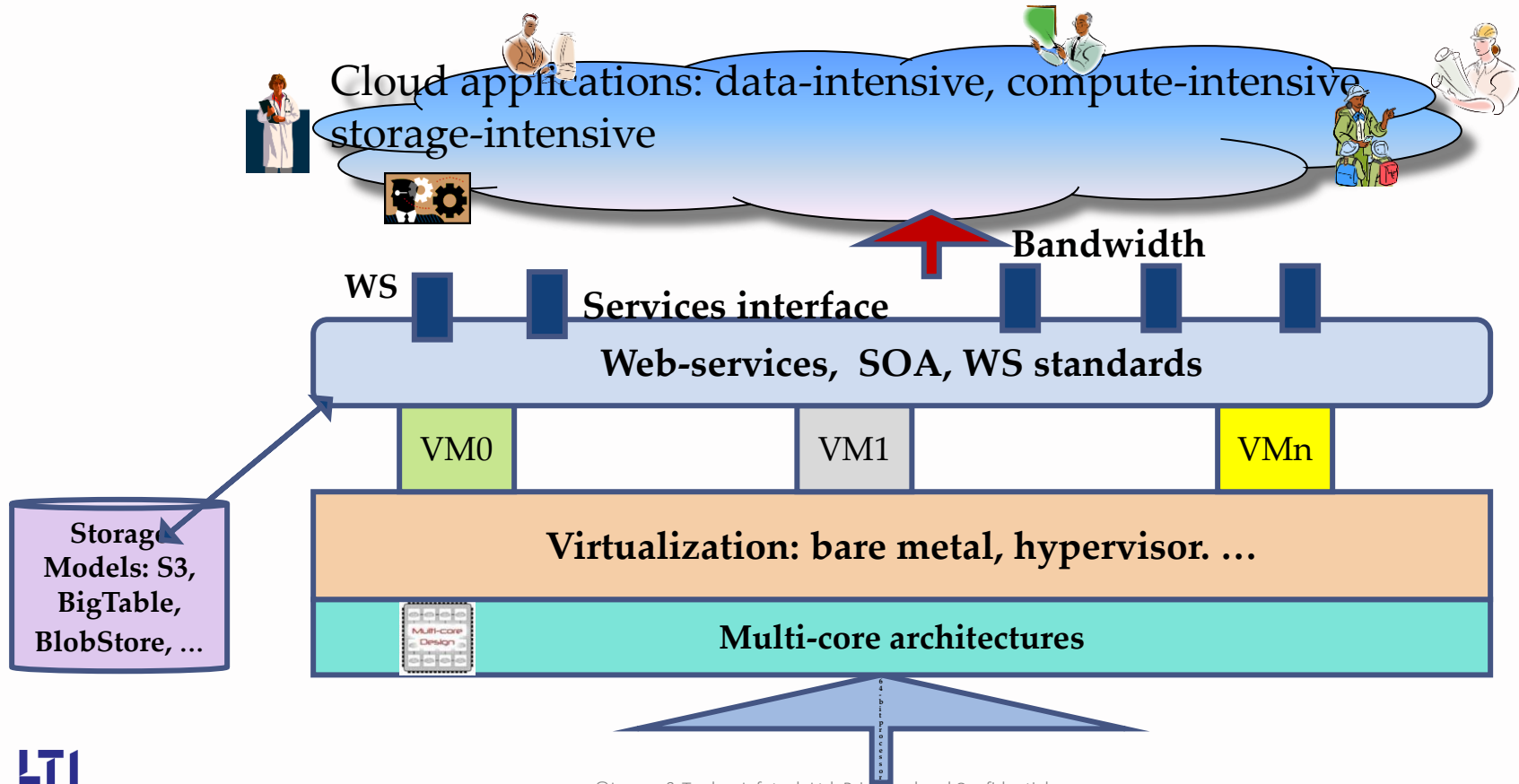
Common Features of Cloud Providers

Development Environment: IDE, SDK, Plugins → Production Environment

Simple storage | Table Store <key, value> | Drives — **Accessible through Web services**

**Management Console and Monitoring tools & multi-level security**

Windows Azure
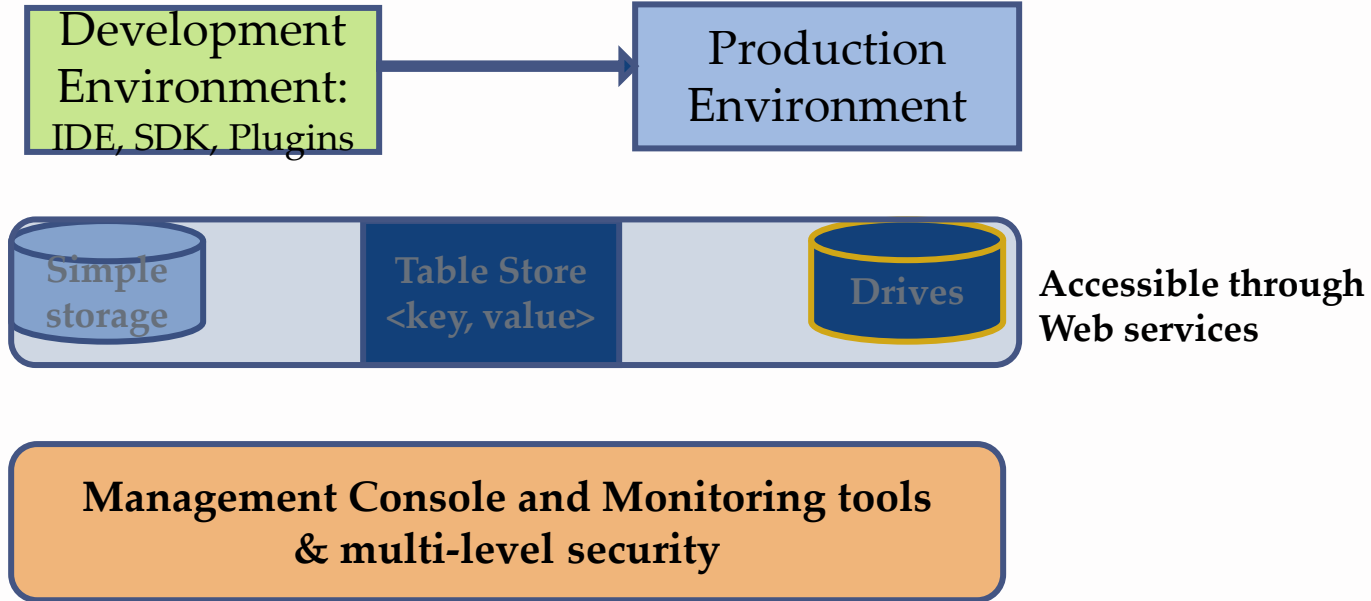
- Enterprise-level on-demand capacity builder
- Fabric of cycles and storage available on-request for a cost
- You have to use Azure API to work with the infrastructure offered by Microsoft
- Significant features: web role, worker role , blob storage, table and drive-storage

Amazon EC2

- Amazon EC2 is one large complex web service.
- EC2 provided an API for instantiating computing instances with any of the operating systems supported.
- It can facilitate computations through Amazon Machine Images (AMIs) for various other models.
- Signature features: S3, Cloud Management Console, MapReduce Cloud, Amazon Machine Image (AMI)
- Excellent distribution, load balancing, cloud monitoring tools

Google App Engine
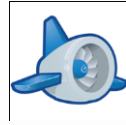
- This is more a web interface for a development environment that offers a one stop facility for design, development and deployment Java and Python-based applications in Java, Go and Python.

- Google offers the same reliability, availability and scalability at par with Google's own applications

- Interface is software programming based

- Comprehensive programming platform irrespective of the size (small or large)

- Signature features: templates and appspot, excellent monitoring and management console

AWS Global Infra Structure

What is a Region?

- A Region is a physical location in the world where AWS have presence across in the form multiple Availability Zones

- As of 2020, AWS has 20Regions

- Each region is a separate geographic area and is completely independent

- Resources aren't replicated across regions unless done explicitly

AWS Global Infrastructure

Region & Number of Availability Zones

New Regions

https://aws.amazon.com/about-aws/global-infrastructure/
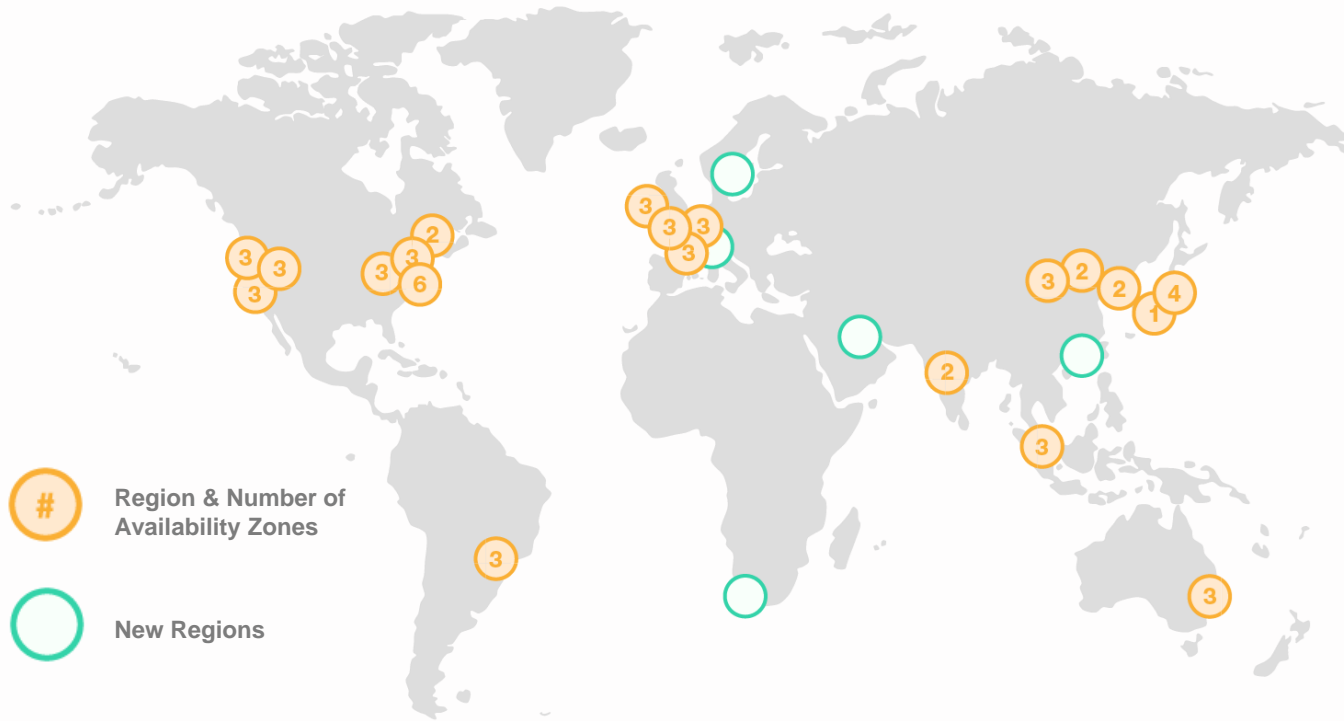
GovCloud (US)
US-East (3),
US-West (3)

US West
Oregon (3), Northern California (3)

US East
Northern Virginia (6), Ohio (3)

Canada
Central (2)

South America
São Paulo (3)

Europe
Ireland (3), Frankfurt (3), London (2), Paris (3)

Asia Pacific
Mumbai (3), Seoul (2), Singapore (3), Sydney (3), Tokyo (4), Osaka-Local (1)

China
Beijing (2), Ningxia (3)

While selecting a region

AWS Services

Latency

Costing

Legal Compliance

Let's Solve

Data center

LTI
Let's Solve

What is an Availability Zone?

- Availability Zones consist of one or more discrete data centers

- As of 2021, AWS Cloud operates 81 Availability Zones within 25 geographic Regions around the world

  Ex:

  us-west-2a, us-west-2b are availabilities Zone in Oregon Region

  us-east-1a , us-east-1c are availabilities Zone in Virginia Region

  ap-south-1a, ap-south-1b and ap-south-1c are availabilities Zone in Mumbai Region

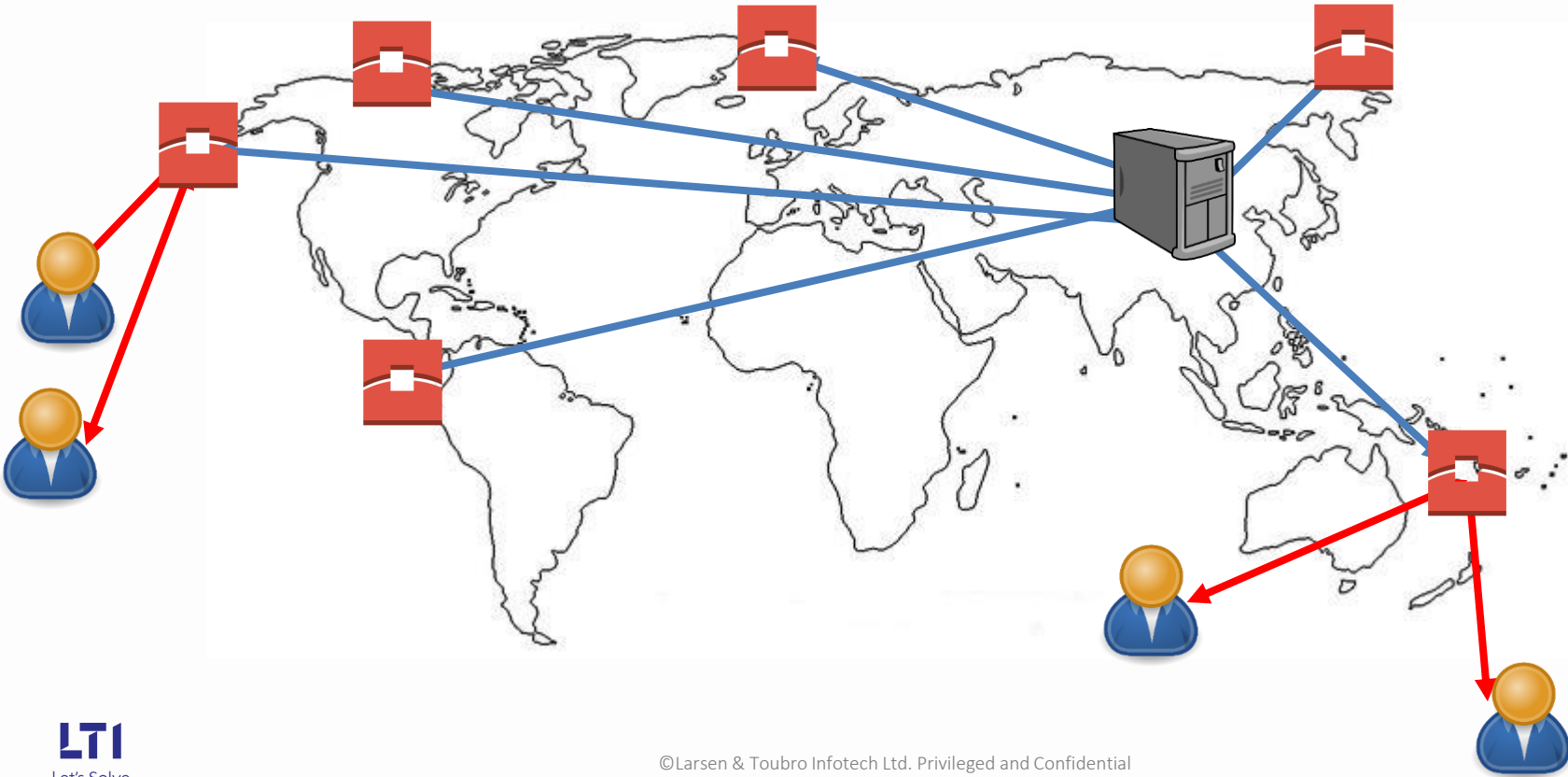 https://docs.aws.amazon.com/general/latest/gr/rande.html

AWS EDGE LOCATION

▪ Locations where end users access services

▪ Those are located in most of the major cities around the world

▪ Specifically used by CloudFront (CDN) to distribute content to end user to reduce latency

Let's Solve

AWS EDGE LOCATIONS

LT1

Let's Solve