



DALHOUSIE
UNIVERSITY

Inspiring Minds

INTRODUCTION TO CLOUD COMPUTING

Lecture # 2

Course: CSCI 5408 Data Management, Warehousing, and Analytics

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Cloud Characteristics

On-demand Usage

Ubiquitous access

Multi-tenancy

Elasticity

Measured Usage

Resiliency

Cloud Delivery Models

Infrastructure as a Service

Platform as a Service

Software as a Service

Cloud Deployment Models

Public cloud

Community cloud

Private cloud

Hybrid cloud

Cloud Service Providers and Use Cases

Amazon AWS

Microsoft Azure

Digital Ocean

Heroku

Recap of last lecture

Conventional Databases and Big Data

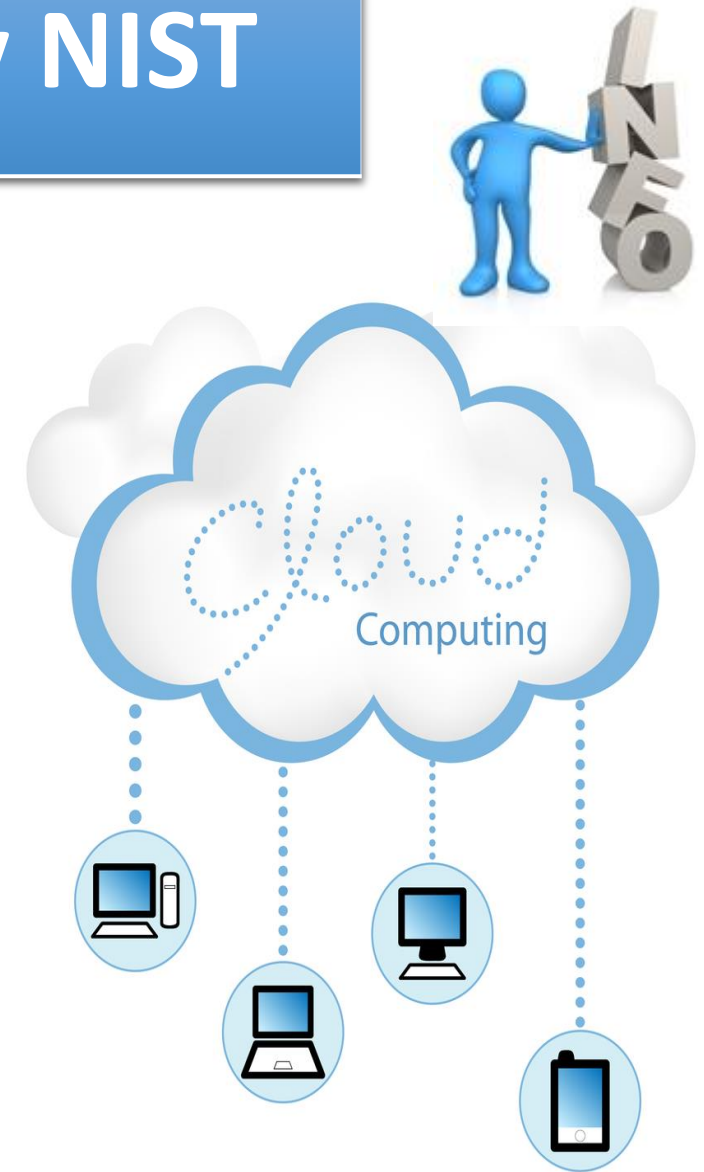
- Q1. Select maximum earning salary employee who reports to manager 'John Chen'?
- Q2. What is the difference between Elastic Search and conventional Query Search?
- Q3. What is the basic difference between RDBMS and NoSQL Databases?
- Q4. Name 3 limitations for conventional database systems
- Q5. What type of NoSQL database is Redis? (Graph, Document, Wide-Column, Key-Value)
- Q6. What is Apache Lucene?

Definition of Cloud Computing by NIST

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

Source:

<http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf>



Who is a Cloud Service Provider?

The organization that provides Cloud Services to customers is called Cloud Service Provider.

Some of the examples are “Amazon (AWS)”, “Microsoft Azure”, “Rackspace”, “Digital Ocean”, “Heroku”, “Salesforce”, etc

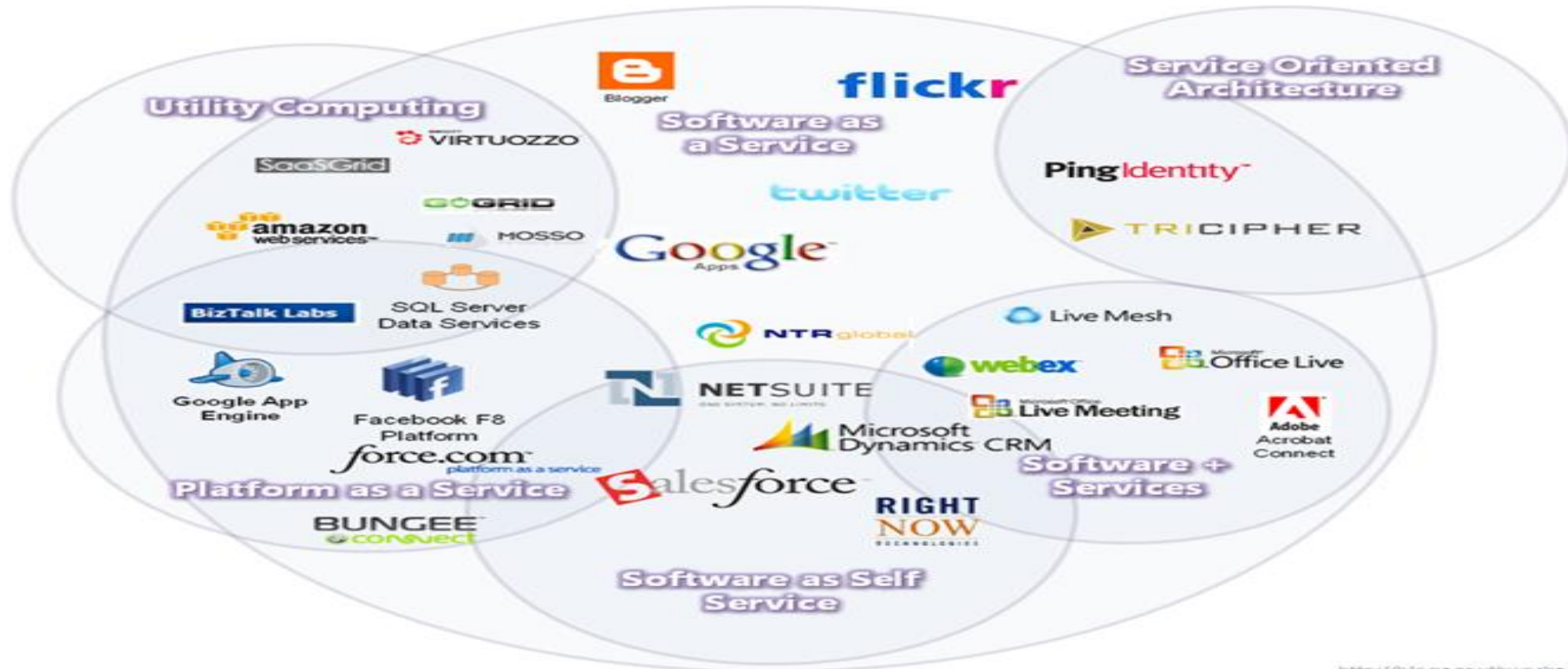
Cloud service providers normally own IT resources required for setting up Cloud infrastructure and lease it to Cloud consumers

Some cloud service providers might also “resell” IT resources leased by other cloud providers

Cloud Service Provider are responsible for fulfilling SLA (Service Level Agreements) made between them and consumers

Examples of Cloud Service Provider

The organization that provides Cloud Services to customers is called Cloud Service Provider. Some of the examples are “Amazon (AWS)”, “Microsoft Azure”, “Rackspace”, “Digital Ocean”, “Heroku”, “Salesforce”, etc

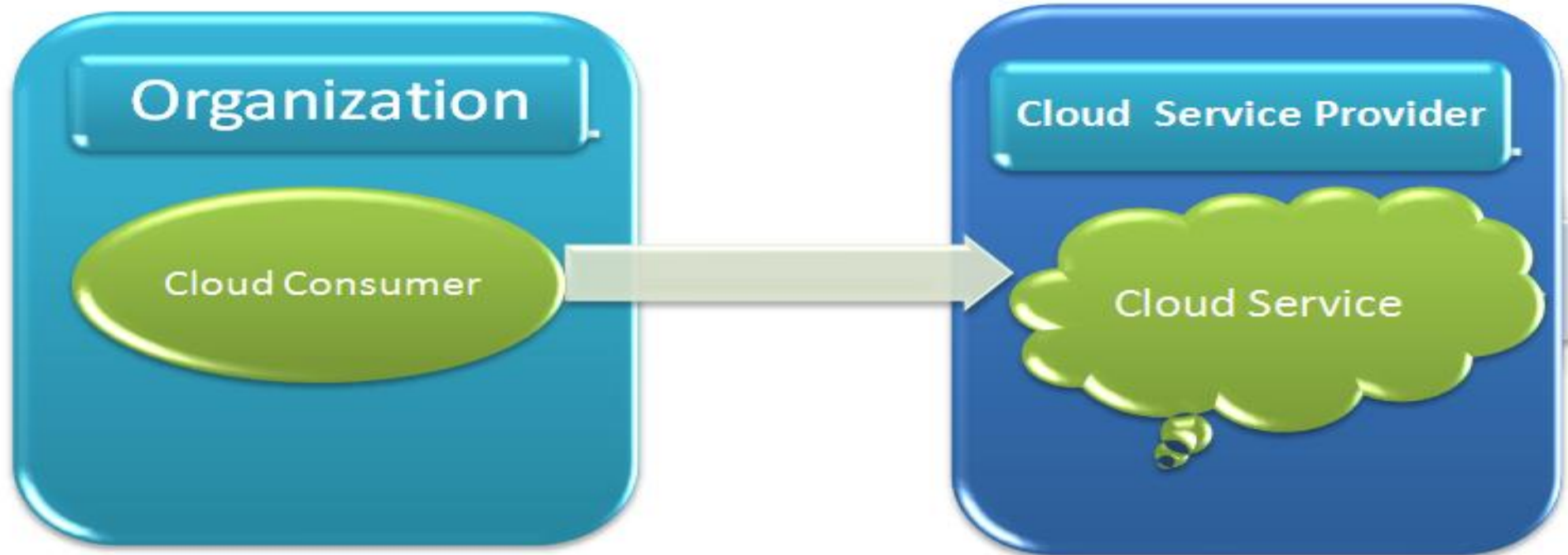


<http://blogs.southworks.com>

Who is Cloud Consumer?



“A cloud consumer is an individual or a company using cloud services made available by cloud service provider and through a legal contract or SLA (Service Level Agreement)”

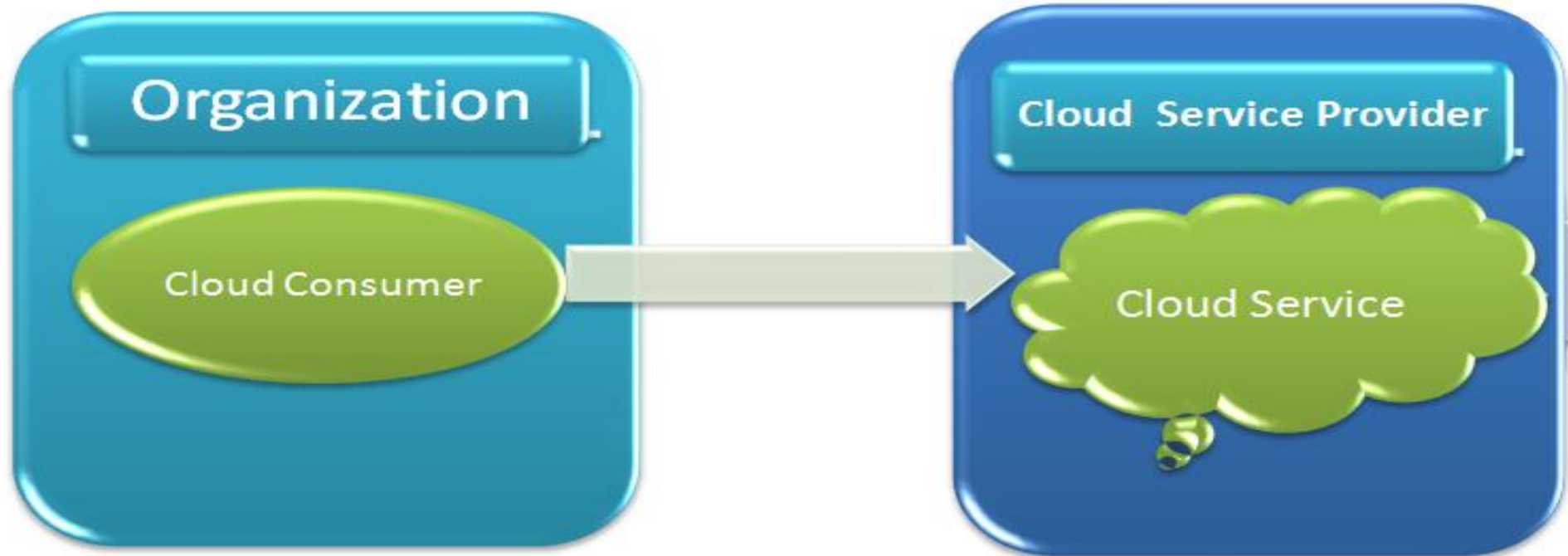


Who is Cloud Service Owner?



The person or organization that legally owns a cloud service is called cloud service owner

Several cloud consumer organizations develop and deploy cloud services in clouds owned by other parties



Who is Cloud Resource Administrator?

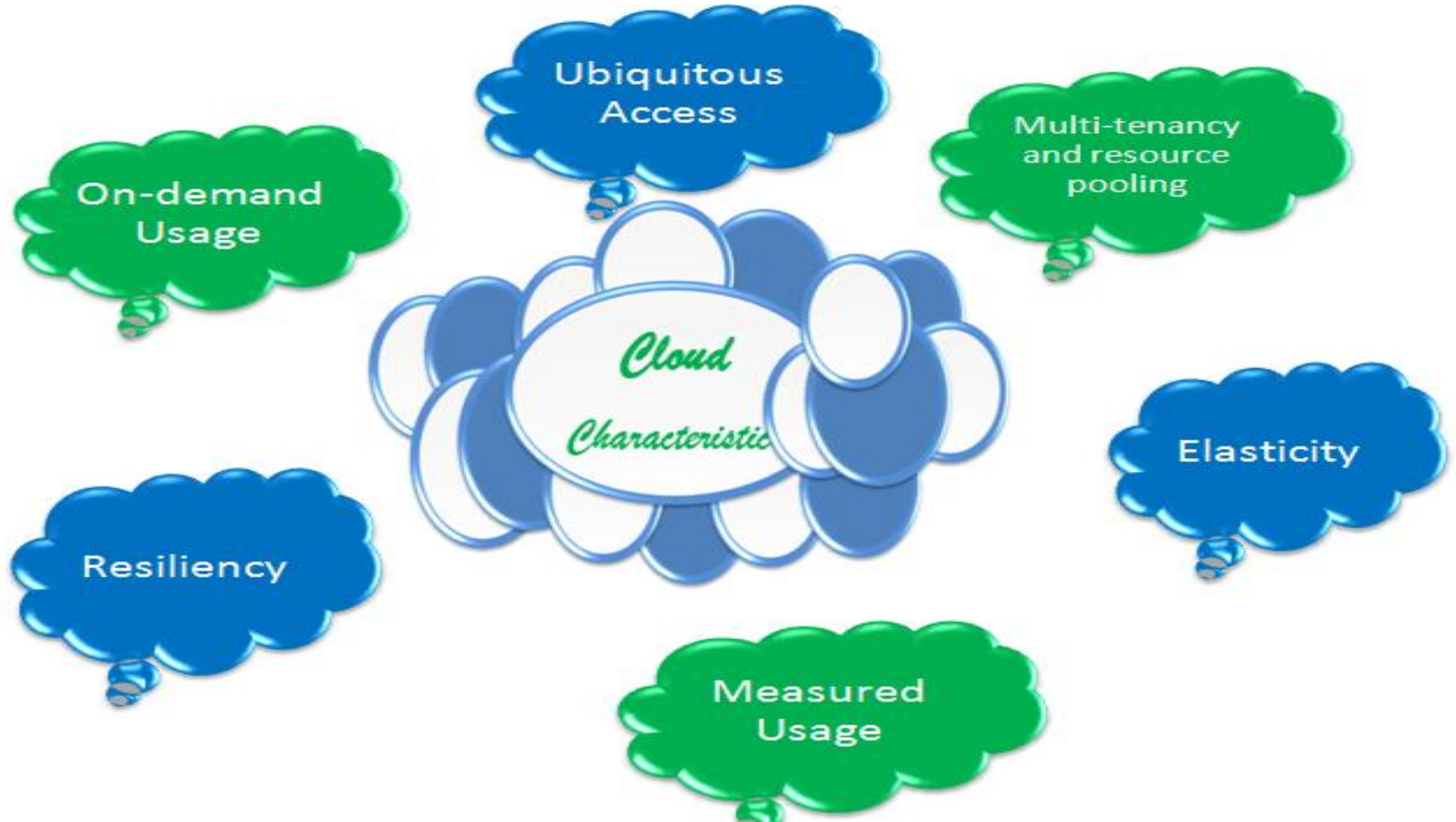


A cloud resource administrator is the person responsible for administering a cloud-based IT resource.

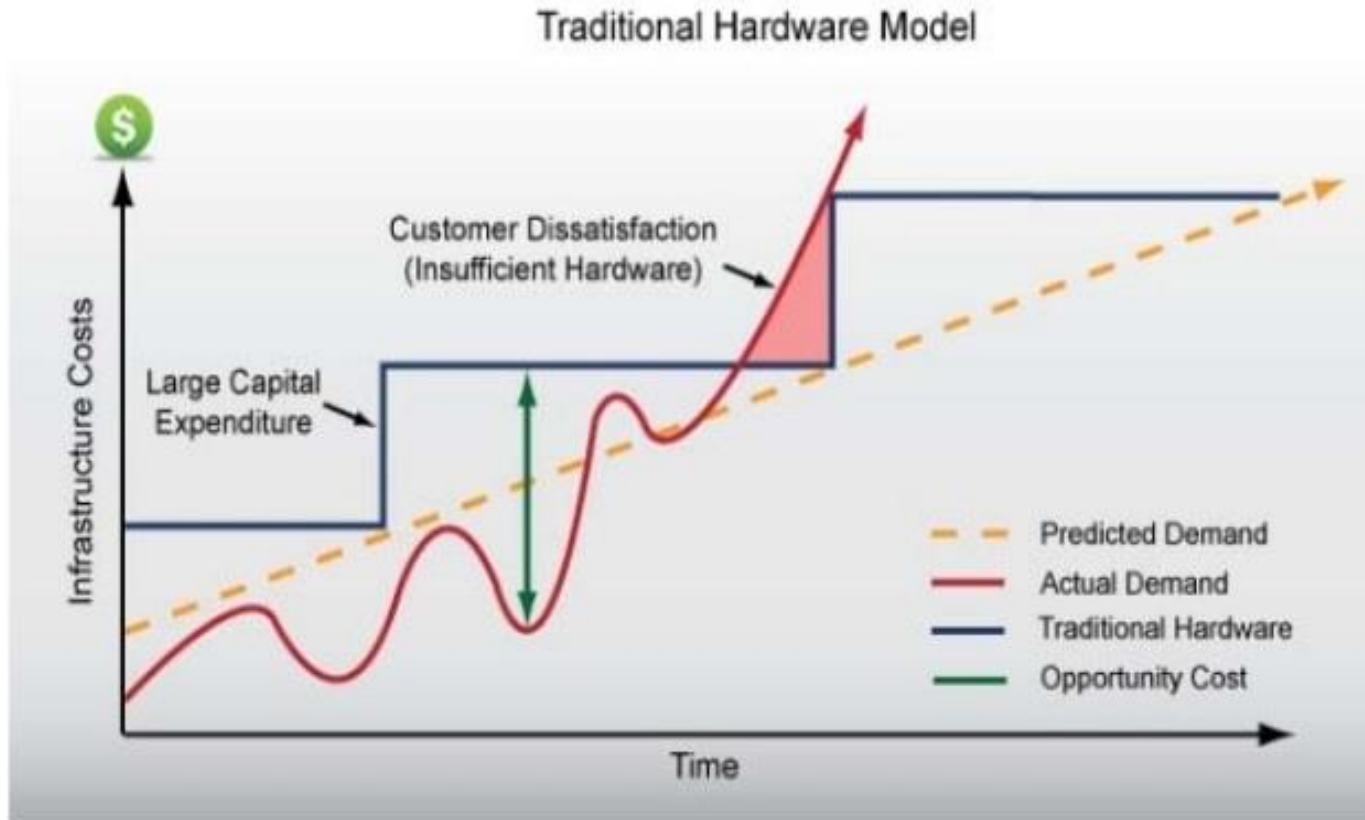
A cloud service owner can contract a cloud resource administrator to administer a cloud service



Cloud Characteristics



Cloud Characteristics



* <http://www.righthscale.com/products/cloud-computing-uses/scalable-websites.php>

On-demand Usage

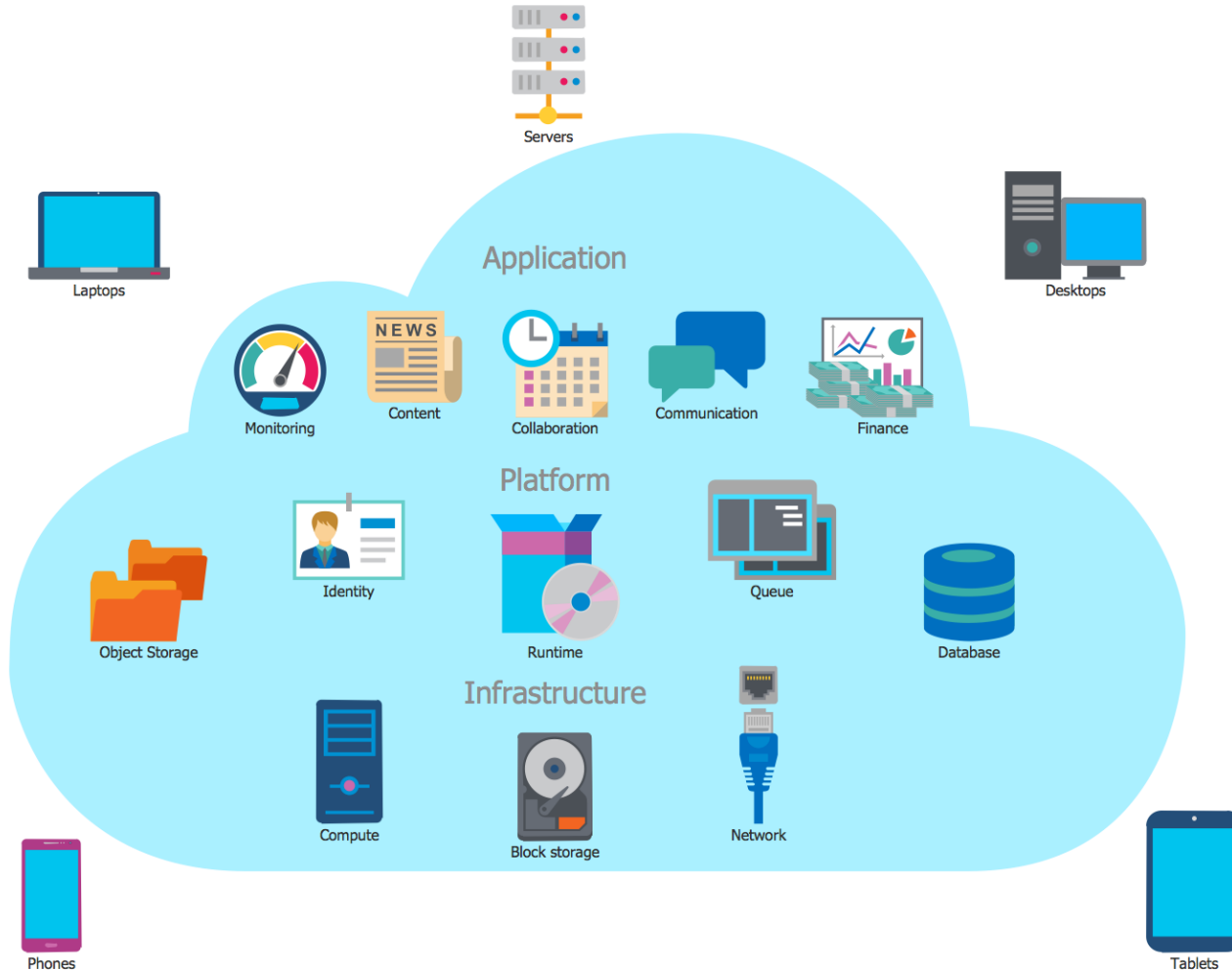
A cloud service is available to consumers on-demand whenever required

A cloud consumer can self provision the resource with minimal external help from provider

Automation is the key when delivering cloud based services to consumers

On-demand usage minimizes human involvement in maintaining cloud services and leave the configuration to cloud consumer with set features to chose from

Cloud Characteristics



Source: <http://www.conceptdraw.com/How-To-Guide/picture/cloud-computing-architecture-diagrams/Computer-Networks-Cloud-Computing-Diagrams-Cloud-Computing.png>

Ubiquitous Access

Ubiquitous represents the ability for a cloud to be widely accessible

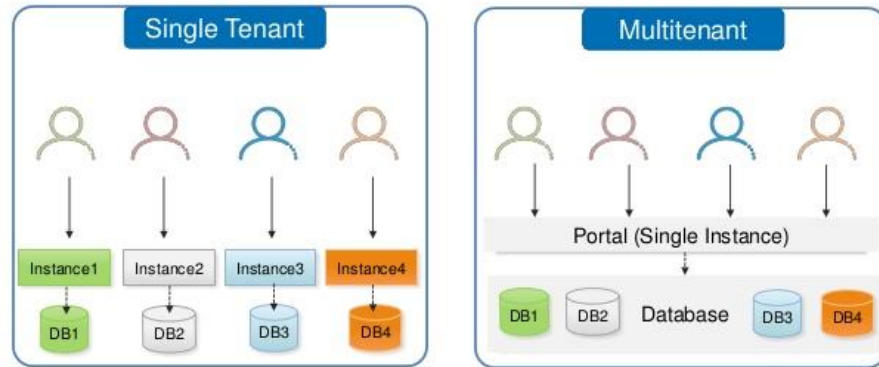
Cloud services are normally tested with a range of devices and environments to make sure it can function properly with different types of consumers

Different types of security mechanisms and interfaces are implemented in clouds to meet the demands of consumers

Cloud service architecture is tailored to the specific needs of the consumers of different regions and demographics

Cloud Characteristics

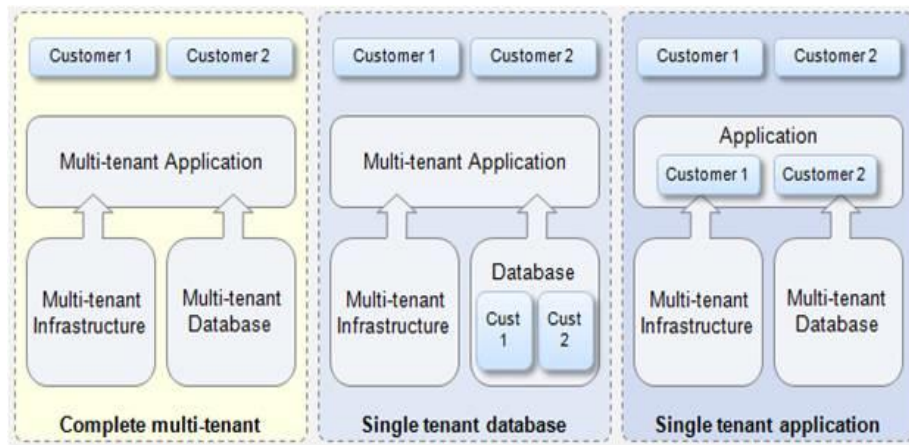
Single vs. Multitenant



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CIGNEX
DATAMATICS

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Multi-tenancy and resource pooling

The ability of a cloud platform to serve different consumers using shared resources at the same time is called multi-tenancy

Cloud providers use virtualization techniques and resource pooling to achieve and serve multiple tenants

IT resources in a Cloud platform can be dynamically assigned and reassigned based on cloud consumer demands

Ability to serve multiple tenants while maintaining high performance and scalability defines the strength of a cloud service provider

Multi-tenancy decreases the cost of IT infrastructure due to sharing of resources on consumers

Source: <http://image.slidesharecdn.com/webinar-leveragingliferaysmulti-tenantarchitecturetoachievetheeconomiesofscale-151110101123-lva1-app6891/95/leveraging-liferay-multi-tenant-architecture-to-achieve-economies-of-scale-4-638.jpg?cb=1447150650>,
<http://blog.techcello.com/wp-content/uploads/2013/04/Multi-Tenancy-Models.jpg>

Cloud Characteristics

Measured Usage

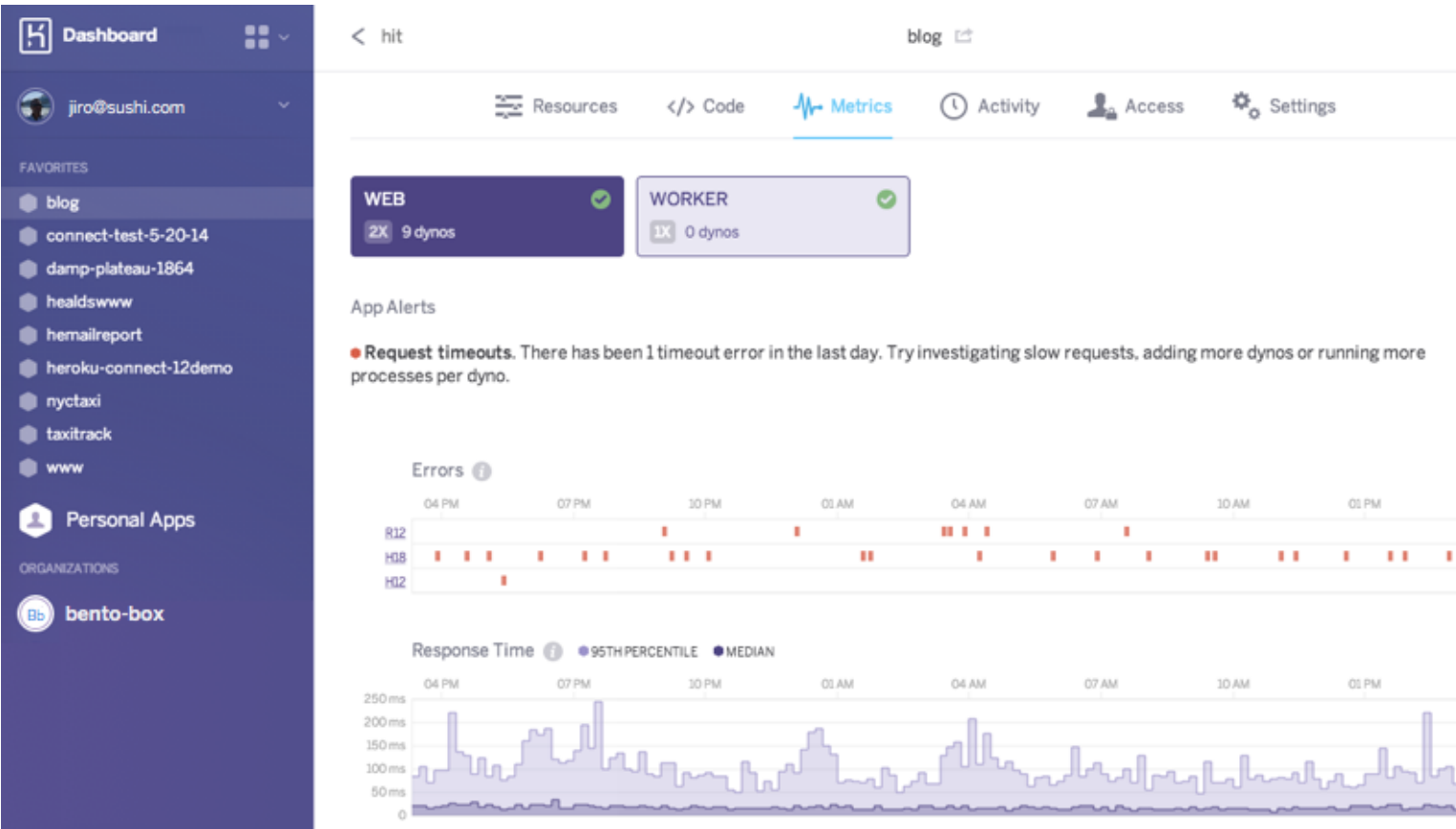
The measured usage represents the ability of a cloud platform to keep track of the usage of its IT resources

Measured usage is a key factor in identifying proper billing for the consumer

In addition to billing metrics, measured usage is also very helpful for consumers in identifying how much resources has been utilized by end users

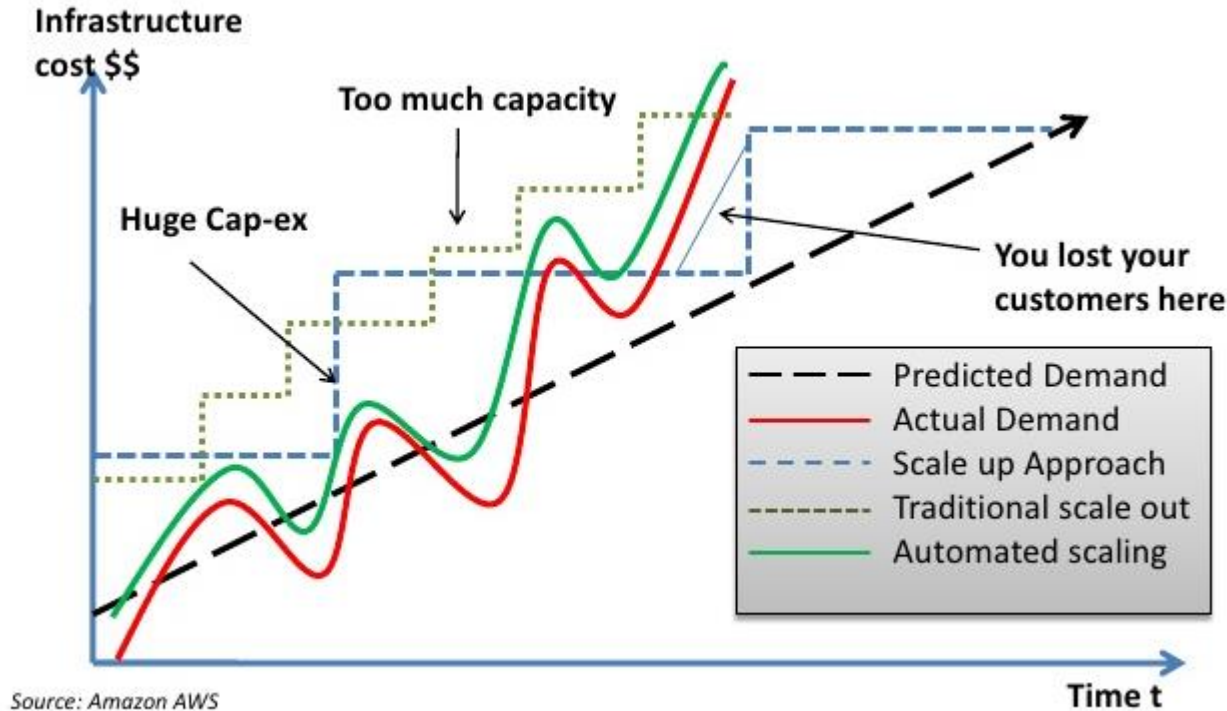
Users have the ability to monitor usage of IT resources on daily basis and react to any alerts if needed

Some cloud providers might charge an extra amount of premium monitoring service with additional alerts



Source: https://heroku-blog-files.s3.amazonaws.com/posts/1473343756-1411580405-screenshot_metrics.png

Cloud Characteristics



Source: http://www.knd.com.au/wp-content/uploads/aws_scaling.png

Elasticity

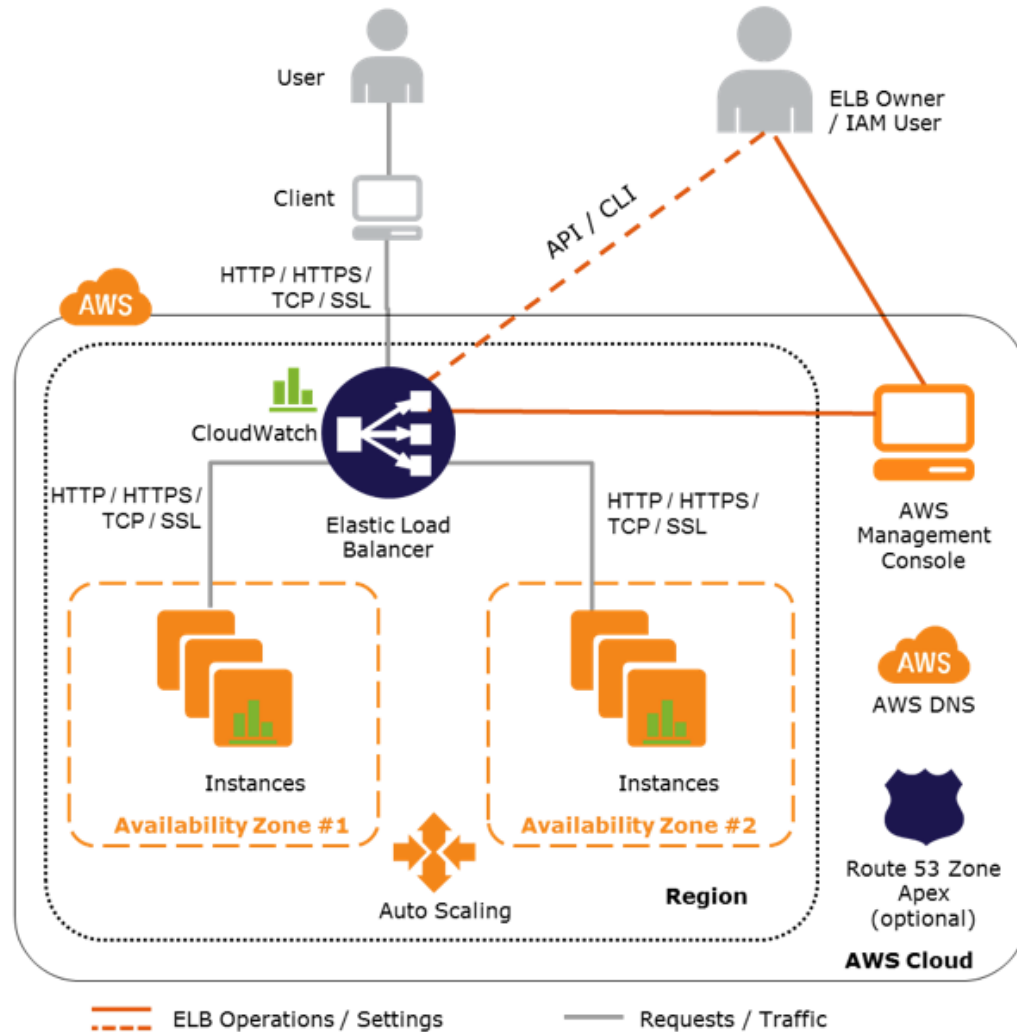
Elasticity is the automated ability of a cloud system to transparently scale resources

Elasticity is considered as one of the main reason to use host resources on clouds

Cloud providers with vast range of IT resources can offer greatest range of elasticity

Elastic systems needs to have strong measures in place for fault tolerance and monitoring

Cloud Characteristics



Source: <http://awsmedia.s3.amazonaws.com/2012-02-24-techdoc-elb-arch.png>

Resiliency

Resilient computing is a form of failover where IT resources can be distributed over different physical servers to provide backup services

It is also parallel to load balancing where user can switch servers based on performance needs or in case of a server failure

This is very necessary in clouds to provide backup service in case of server failures

Cloud consumers can increase both reliability and availability of serves and can add many back up serves as needed

Geographical distribution of serves is a key factor that provides access to quickly reachable resources when needed for consumers

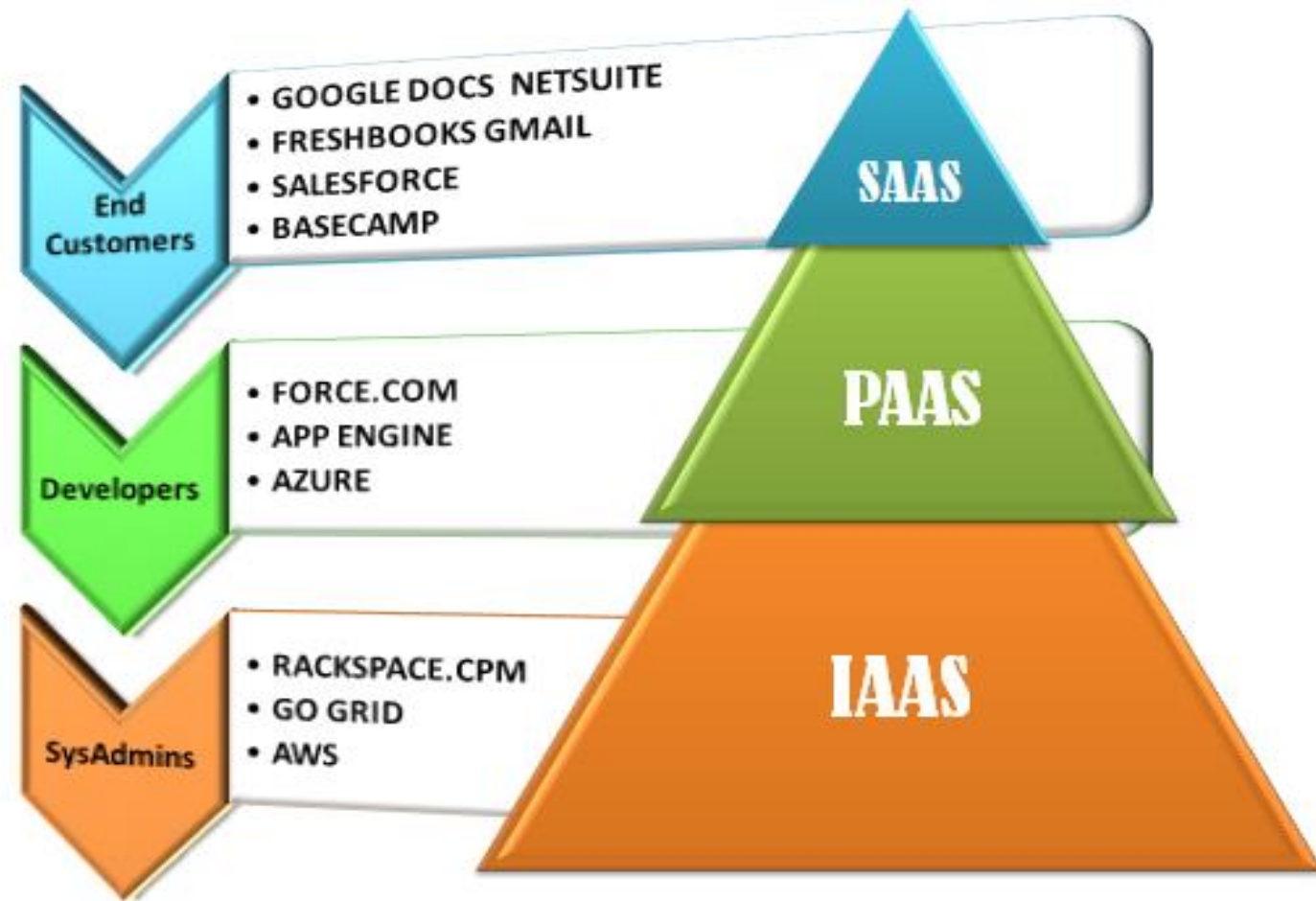
Cloud Delivery Models

Cloud delivery model represents specific, pre-packaged combination of IT resources offered by a Cloud provider

Software As A Service

Platform As A Service

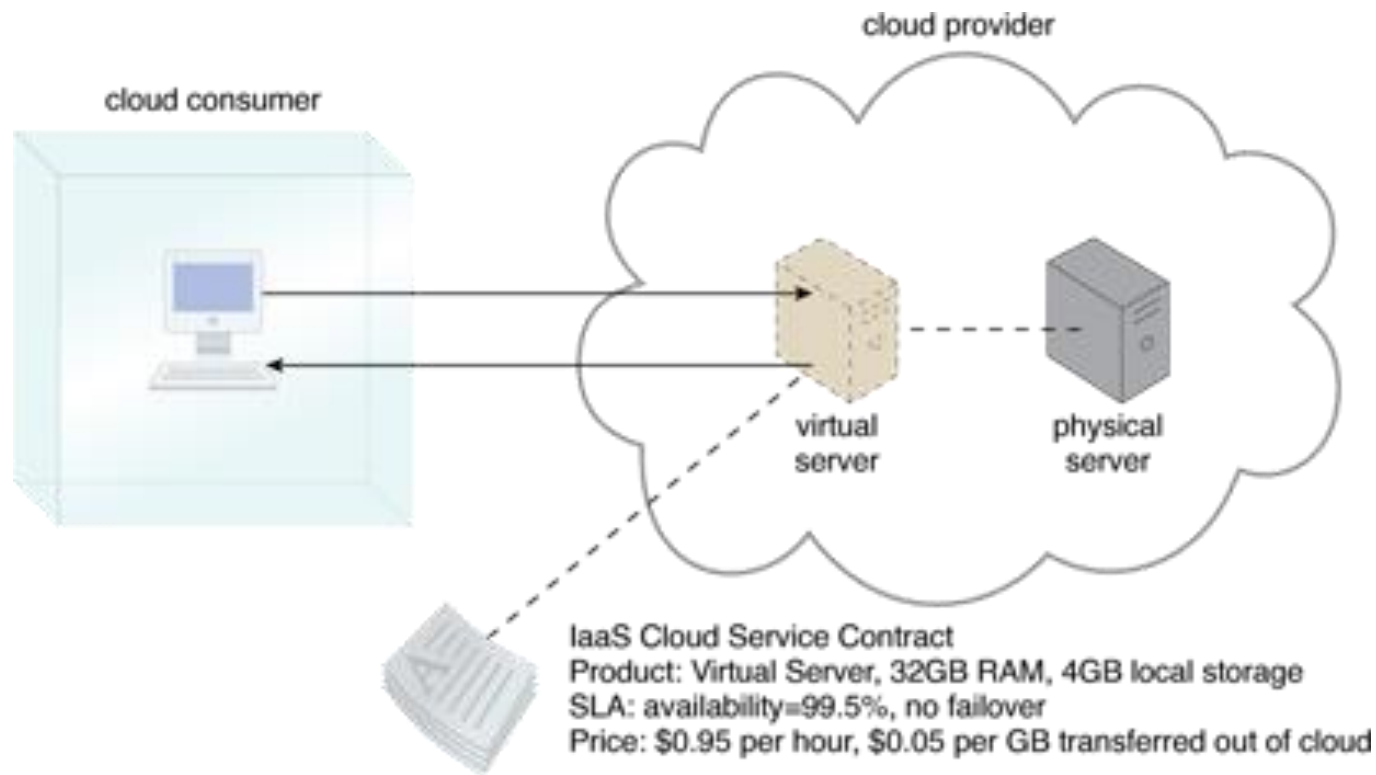
Infrastructure As A Service



Infrastructure as a Service

- Infrastructure as a Service or simply IaaS provides the ability to cloud consumers to control infrastructure environment on the clouds
- This type of environment can include hardware, network, operating system and raw IT resources
- Sometimes cloud providers will contract IaaS offerings from other cloud providers in order to scale their own cloud environments
- Virtual machines are types of Infrastructure resources that are widely used from different consumers
- Infrastructure has more control but not highly scalable

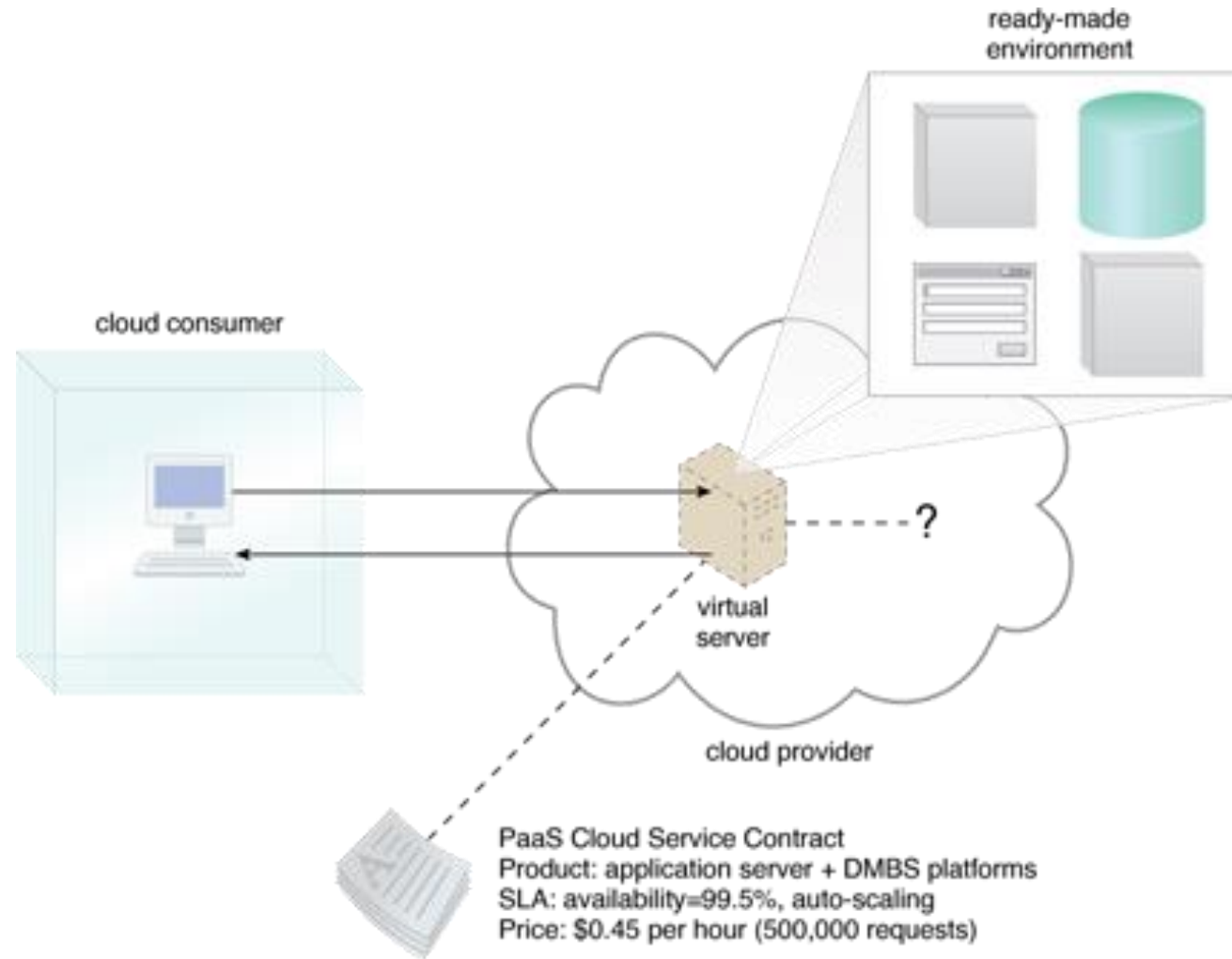
Infrastructure as a Service



Platform as a Service

- PaaS – Platform as a Service represents a pre-defined ready to use environment typically comprised of already deployed ready to use and configured IT resources.
- Managed Web Service, Managed Application Servers, Caching services, Logging services are all examples of platform
- Platform are highly scalable and can scale vertically as well as horizontally
- Billing is more accurate and based on usage from users
- Failover features are more strong and visible in Platforms

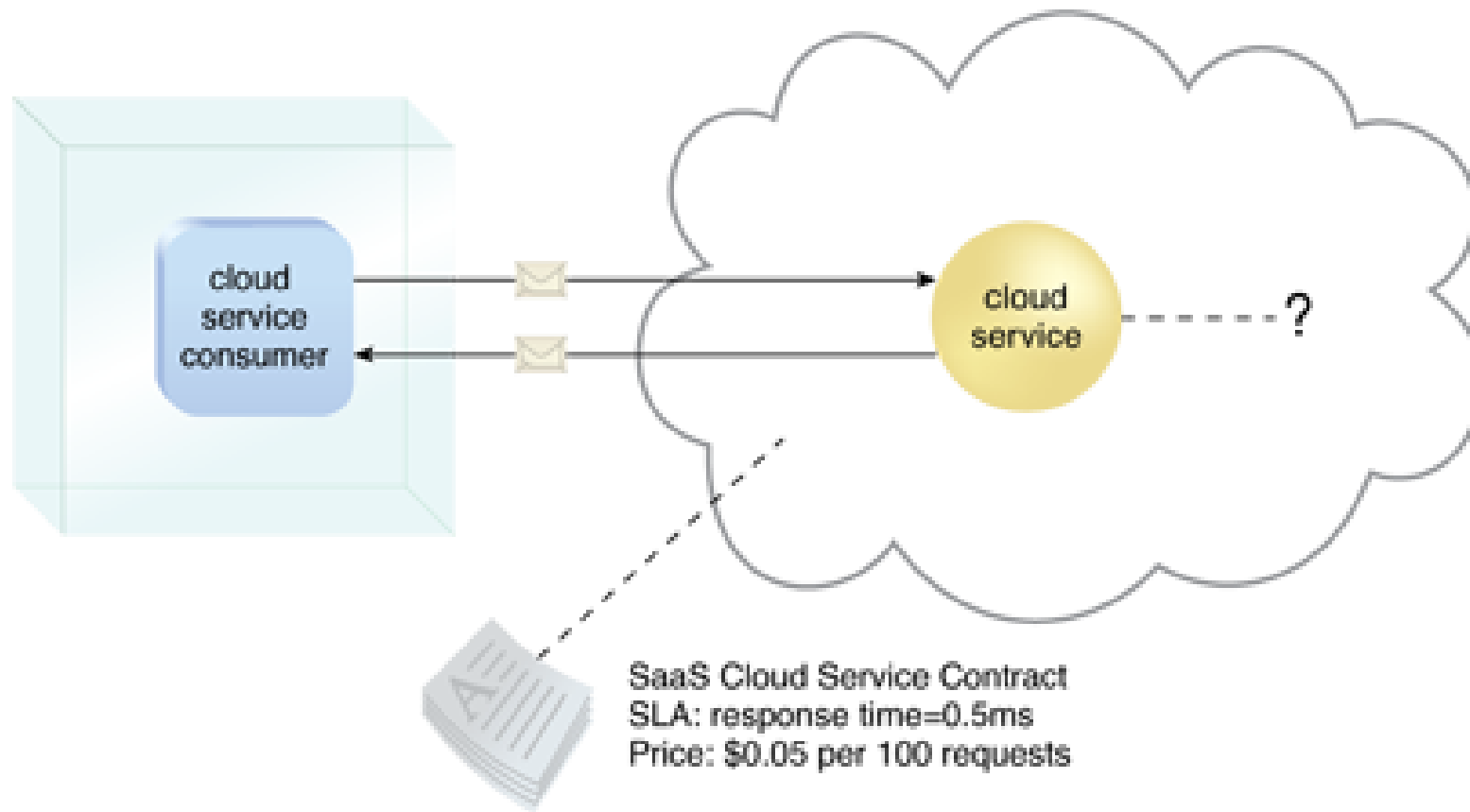
Platform as a Service



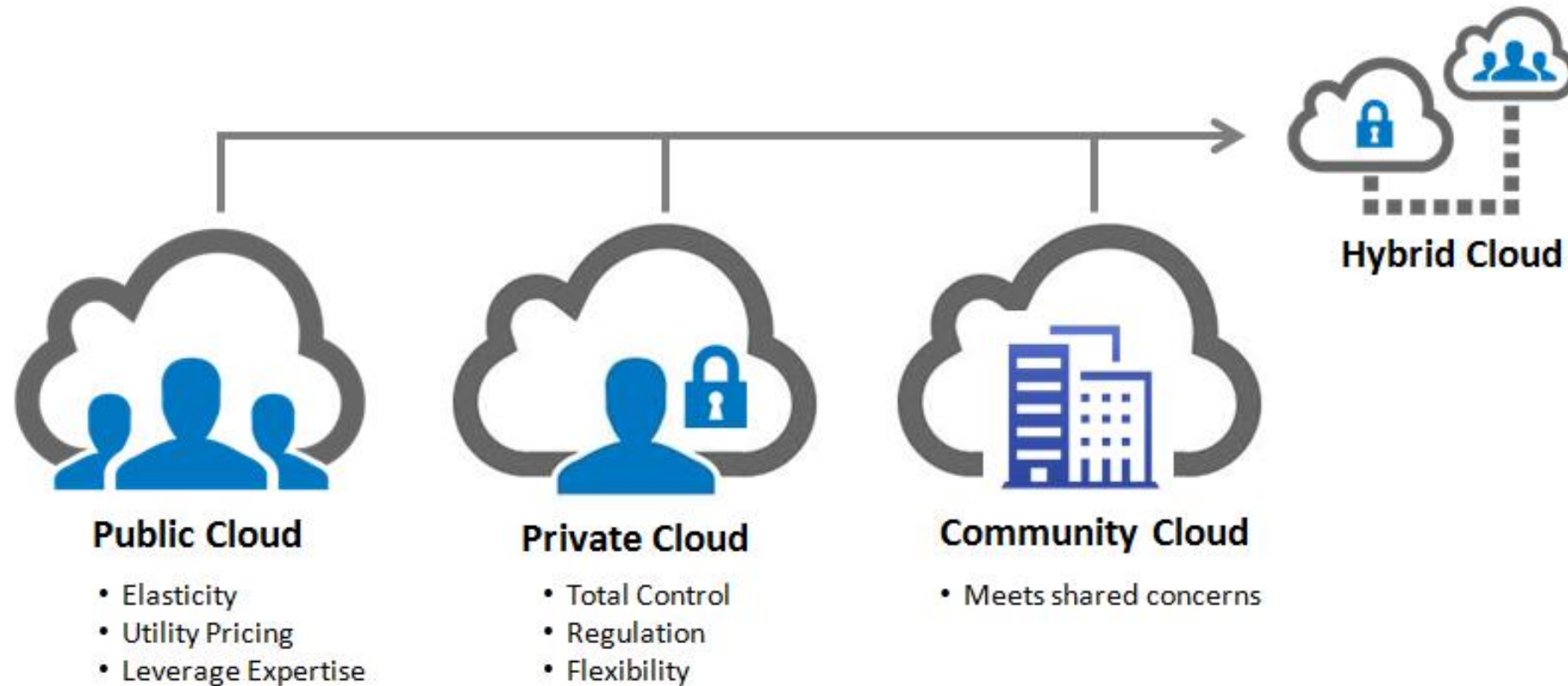
Software as a Service

- SaaS – Software as a Service is a reusable cloud service widely available (often commercially) to a range of cloud consumers
- A cloud consumer is granted very limited administrative control over SaaS
- Software can be configured to individual user needs and can be scaled on demand
- Sometimes Cloud provider offering Software services to consumers are themselves cloud consumers for a platform. They buy platform services and offer software services to their customers

Software as a Service



Cloud Deployment Models



Source: <http://cloudcomputingtypes.com/wp-content/uploads/2016/04/Cloud-Computing-Deployment-Models.png>

Private Clouds

A private Cloud is owned by a single organization which is more customized to their needs

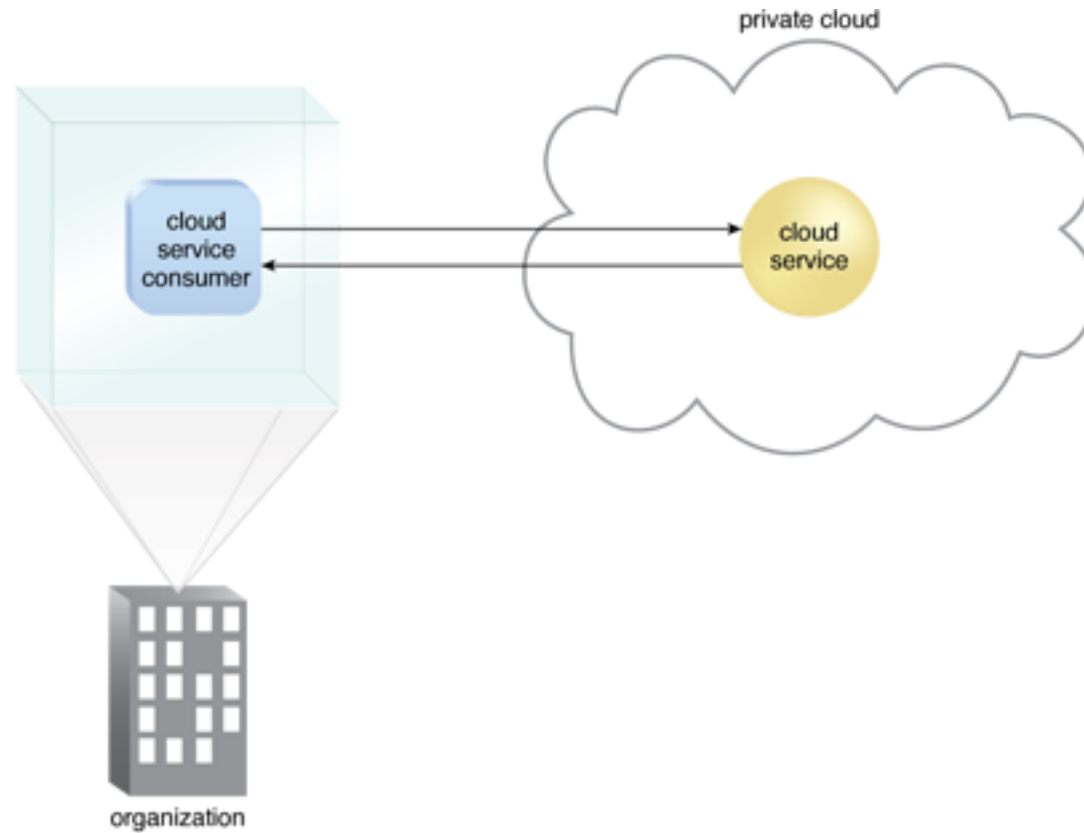
Private clouds enable an organization to use cloud technology as a means of centralizing access to IT resources

Private clouds exist in a more controlled environment

The boundaries of private clouds can change depending on organization policy

Often with private cloud an organization is both a consumer and a provider. However, an organization can purchase a private cloud from a third party

Private Clouds



Public Clouds

A public cloud is a publicly accessible cloud environment owned by a third party cloud provider

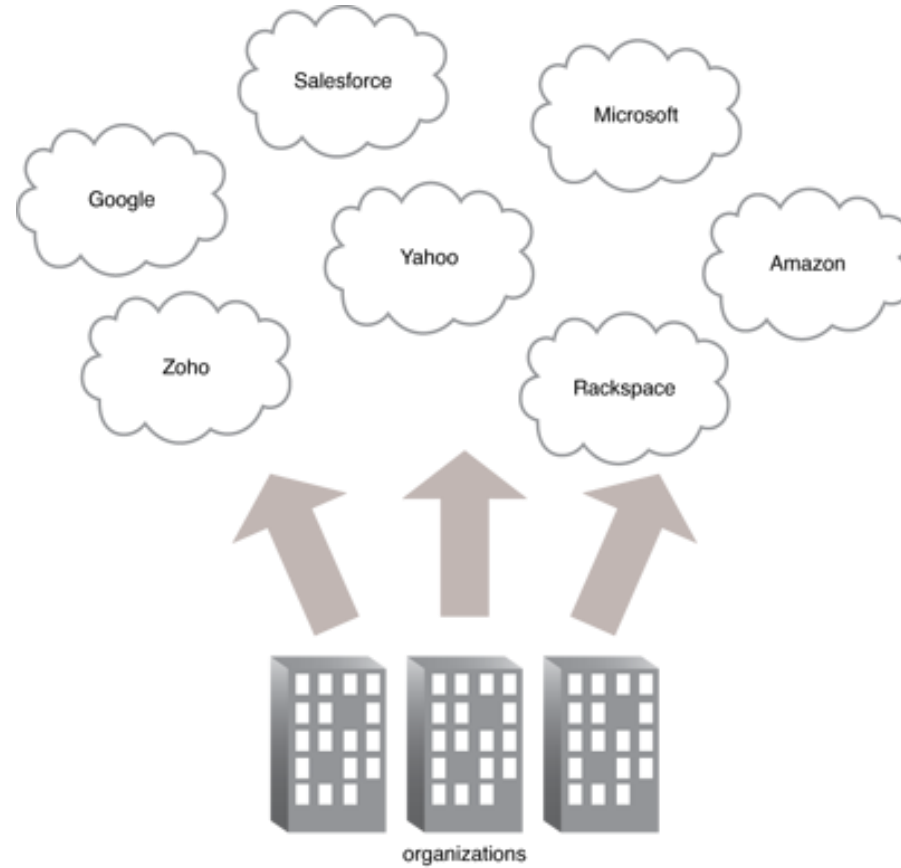
Cloud provider is responsible for the creation and on-going maintenance of the public cloud

Cloud provider provides billing contract and service level agreement for all consumers

Resources are widely accessible for different consumers

Contact centers are established in case of any dispute

Public Clouds



Hybrid Clouds

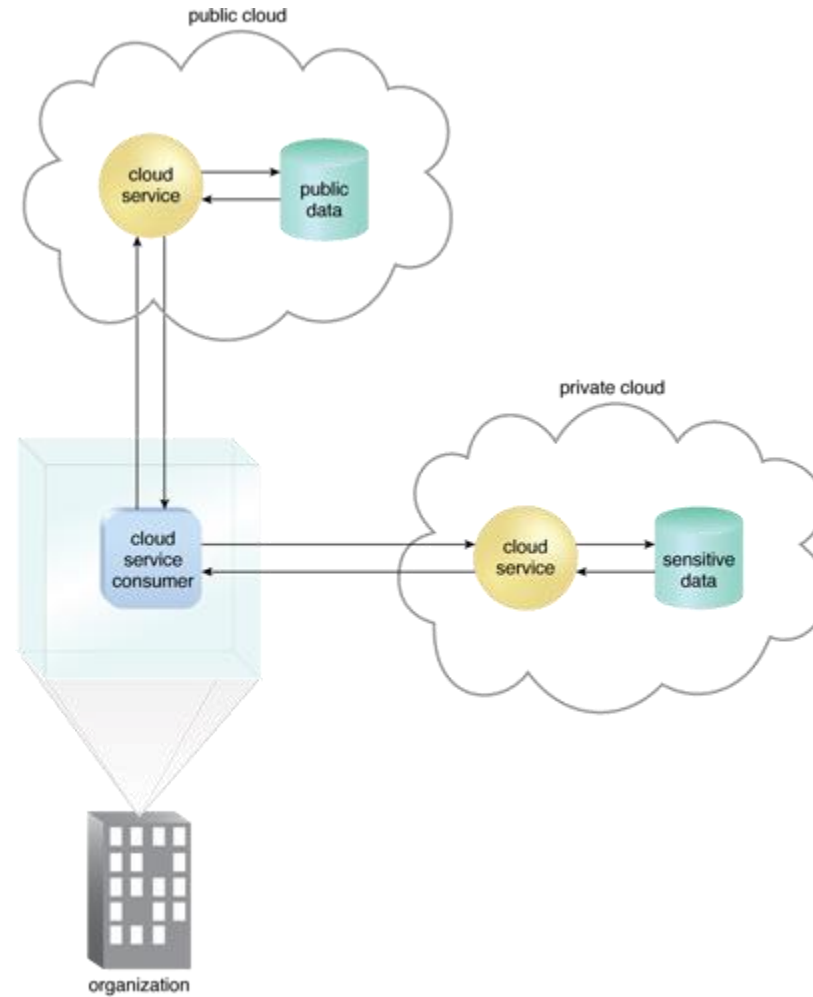
A hybrid cloud is a cloud environment comprised of two or more cloud deployment models

Consumer have ability to pick and chose which area he wants to deploy code/data

Hybrid cloud can be complex and challenging to use. It is not widely used in Industry but a possibility

Management responsibilities are typically distributed between two cloud deployments

Hybrid Clouds



Community Clouds

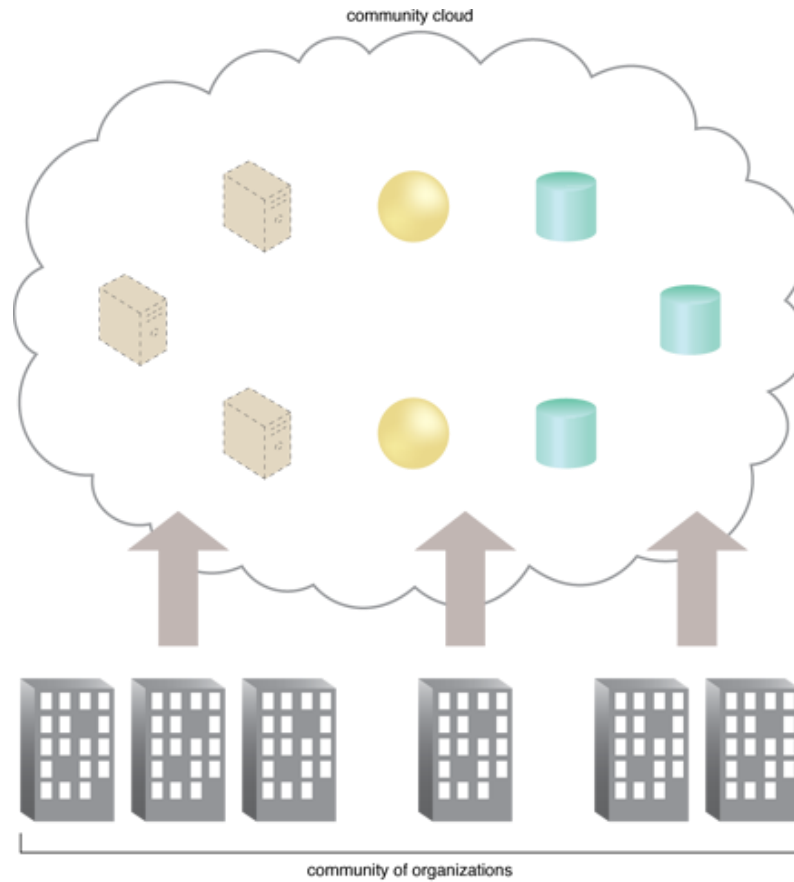
Community clouds are similar to public clouds except that their access are limited to a particular community

Community cloud might be jointly owned by a community or a third party

The members of cloud community typically share responsibility of defining and evolving the community cloud

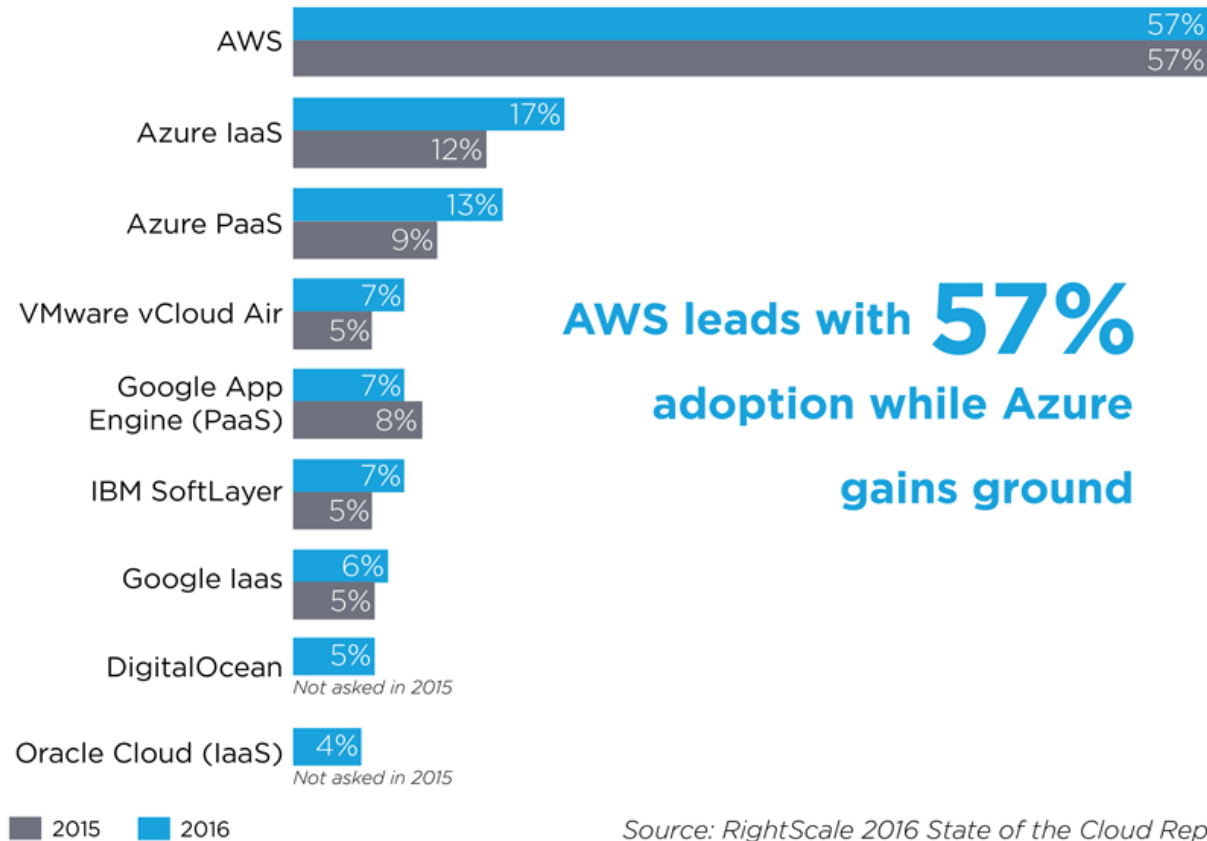
Membership to cloud community does not necessarily guarantee access to all cloud IT resources

Community Clouds



Right Scale 2016 vs 2015 Cloud usage

Respondents Running Apps 2016 vs. 2015



Case Study: ABC Insurance Company

Scenario:

ABC Insurance company is looking to expand their IT infrastructure and move it to Cloud. But they are unaware about which cloud service would be best for them to use. They need help to better understand cost and resource metrics. Their requirements are:

- They need to add 300 Sales Agents to add to a system where they can track Time, Invoices, Sales, Sick Leaves, Productivity, Accounts, Opportunities, Cases, etc
- They want to decrease the cost of their IT infrastructure but want high level of monitoring of their resource utilizations
- They don't want to spend time doing low level customizations
- They want ability to scale dynamically
- Their data is private and they are very cautious about data security and privacy
- They have plenty of budget on user training
- They want their services to be up and running 99.99% of the time with available failover

Please design a system on Cloud which can provide them above services. Indicate what they should use for Cloud deployment model, delivery model and characteristics.

Case Study: ABC Insurance Company

Quiz

- What unique features do Platform (PaaS) provide that Infrastructure cannot provide?
- Why are Public clouds more popular in industry than any other deployment model?
- What does a resource administrator of Cloud need to do in case of a fail over?
- How can we increase elasticity in Cloud system?
- Which characteristic is used to indicate amount of usage in Cloud?
- If I need to add a node to existing Cloud resources, do I need to contact provider?

Reading Material

Resource # 1

Chapter 4, Cloud Computing: Concepts, Technology & Architecture

<https://www.safaribooksonline.com/library/view/cloud-computing-concepts/9780133387568/ch04.html>

Resource # 2

Jadeja, Yashpalsinh, and Kirit Modi. "Cloud computing-concepts, architecture and challenges." *Computing, Electronics and Electrical Technologies (ICCEET), 2012 International Conference on*. IEEE, 2012.

http://s3.amazonaws.com/academia.edu.documents/32026251/IEEE_06203873.pdf?AWSAccessKeyId=AKIAJ56TQJRTWSMTNPEA&Expires=1484239400&Signature=nWggjo6o01NNeQH1Qs%2FjzAhlZ70%3D&response-content-disposition=inline%3B%20filename%3DCloud_computing_-_concepts_architecture.pdf

ANY
QUESTIONS
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