Cloud Computing

Introduction

- **Cloud Computing** has become the buzzing topic of today's technology, driving mainly by marketing and services offered by prominent corporate organizations like Google, IBM & Amazon.

- Cloud computing is the next stage to evolve the Internet. Though for some people, "Cloud Computing" is a big deal, it is not.

- In reality, cloud computing is something that we have been using for a long time; it is the internet facility, along with the associated standards that provide a set of web-services to users.

- When users draw the term 'Internet' as a "cloud", they represent the essential characteristics of cloud computing.

History of Cloud Computing

- Before cloud computing emerged, there was client/server computing, centralized storage in which all the data, software applications and all the controls reside on the server side.

- If a user wants to run a program or access a specific data, then he connects to the server and gain appropriate access and can do his business.

- Distributed computing concept came after this, where all the computers are networked together and resources are shared when needed.

- The Cloud Computing concept came into the picture in the year 1950 with accessible via thin/static clients and the implementation of mainframe computers.

- Then in 1961, John McCarthy delivered a speech at MIT in which he suggested that computing can be sold like a utility like electricity and food.

- The idea was great but it was much ahead of its time and despite having an interest in the model, the technology at that time was not ready for it.

History of Cloud Computing…

- In 1999, Salesforce.com became the 1st company to enter the cloud arena, excelling the concept of providing enterprise-level applications to end users through the Internet.

- Then in 2002, **Amazon** came up with Amazon Web Services, providing services like computation, storage, and even human intelligence. *In 2009,* **Google Apps** and **Microsoft's Windows Azure** also started to provide cloud computing enterprise applications.

- Other companies like HP and Oracle also joined the stream of cloud computing, for fulfilling the need for greater data storage.

Grid Computing

- When we switch on the fan or any electric device, we are less concern about the power supply from where it comes and how it is generated.

- The power supply or electricity that we receives at our home travels through a chain of network, which includes power stations, transformers, power lines and transmission stations.

- These components together make a 'Power Grid'. Likewise, 'Grid Computing' is an infrastructure that links computing resources such as PCs, servers, workstations and storage elements and provides the mechanism required to access them.

- Grid Computing is a subset of **distributed computing**, where a virtual super computer comprises of machines on a network connected by some bus, mostly Ethernet or sometimes the Internet.

- It can also be seen as a form of **Parallel Computing** where instead of many CPU cores on a single machine, it contains multiple cores spread across various locations. The concept of grid computing isn't new, but it is not yet perfected as there are no standard rules and protocols established and accepted by people.

Grid Computing…

- **Grid Computing** can be defined as a network of computers working together to perform a task that would rather be difficult for a single machine. All machines on that network work under the same protocol to act like a virtual supercomputer.

- The task that they work on may include analyzing huge datasets or simulating situations which require high computing power. Computers on the network contribute resources like processing power and storage capacity to the network.

Cloud Computing Definition

- According to the official **National Institute of Standards and Technology's(NIST)** definition:

   "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."

- The NIST definition lists five essential characteristics of cloud computing: **on-demand self-service, broad network access, resource pooling, rapid elasticity** or **expansion,** and **measured service**.

- It also lists three "service models" (**software, platform** and **infrastructure**),

- and four "deployment models" (**private, community, public** and **hybrid**) that together categorize ways to deliver cloud services.

- The definition is intended to serve as a means for broad comparisons of cloud services and deployment strategies, and to provide a baseline for discussion from what is cloud computing to how to best use cloud computing.

Benefits of Cloud Computing

- The potential for cost saving is the major reason of cloud services adoption by many organizations.
- Cloud computing gives the freedom to use services as per the requirement and pay only for what you use.
- Due to cloud computing it has become possible to run IT operations as a outsourced unit without much in-house resources.
- Lower IT infrastructure and computer costs for users
- Improved performance
- Fewer Maintenance issues
- Instant software updates
- Improved compatibility between Operating systems
- Backup and recovery
- Performance and Scalability
- Increased storage capacity
- Increase data safety

Cloud Computing Deployment Methods

1. **Private Cloud**
2. Public Cloud
3. Community Cloud
4. Hybrid Cloud

- **Private Cloud:** A particular Cloud Company maintains the management, deployment, and operation of the cloud. The operation can be in-house or with a third party.

- **Community Cloud:** The companies having similar interest and work can share the same cloud and it can be done with the help of **Community Cloud**. The initial investment is saved, as the setup is established.

- **Public Cloud:** the company serves the infrastructure to the customer on a commercial basis. This helps the customer to develop and deploy the application with minimum financial outlay.

- **Hybrid Cloud:** there is an ease to move the application to move from one cloud to another. Hybrid Cloud is a combination of Public and Private Cloud which supports the requirement to handle data in an organization.

Service models

- The three major Cloud Computing Offerings are
    1. **Software as a Service (SaaS)**
    2. **Platform as a Service (PaaS)**
    3. **Infrastructure as a Service (IaaS)**

Service models : SaaS (Software as a Service)

- SaaS or software as a service is a software distribution model in which applications are hosted by a vendor or service provider and made available to customers over a network (internet).

- SaaS is becoming an increasingly prevalent delivery model as underlying technologies that supports **Service Oriented Architecture (SOA) or Web Services**. Through internet this service is available to users anywhere in the world.

- Traditionaly, software application needed to be purchased upfront &then installed it onto your computer. SaaS users on the other hand, instead of purchasing the software subscribes to it, usually on monthly basisvia internet.

- Anyone who needs an access to a particular piece of software can be subscribe as a user, whether it is one or two people or every thousands of employees in a corporation. SaaS is compatible with all internet enabled devices.

- Many important tasks like accounting, sales, invoicing and planning all can be performed using SaaS.

Service models : PaaS (Platform as a Service)

- Platform as a service, is referred as PaaS, it provides a platform and environment to allow developers to build applications and services. This service is hosted in the cloud and accessed by the users via internet.

- It provides platform to support application development. It includes software support and management services, storage, networking, deploying, testing, collaborating, hosting and maintaining applications.

Service models : IaaS (Infrastructure as a Service)

- It provides access to computing resources in a virtualized environment "the cloud" on internet.

- It provides computing infrastructure like virtual server space, network connections, bandwidth, load balancers and IP addresses.

- The pool of hardware resource is extracted from multiple servers and networks usually distributed across numerous data centers. This provides redundancy and reliability to IaaS.

- For small scale businesses who are looking for cutting cost on IT infrastructure, IaaS is one of the solutions.

https://www.bigcommerce.com/
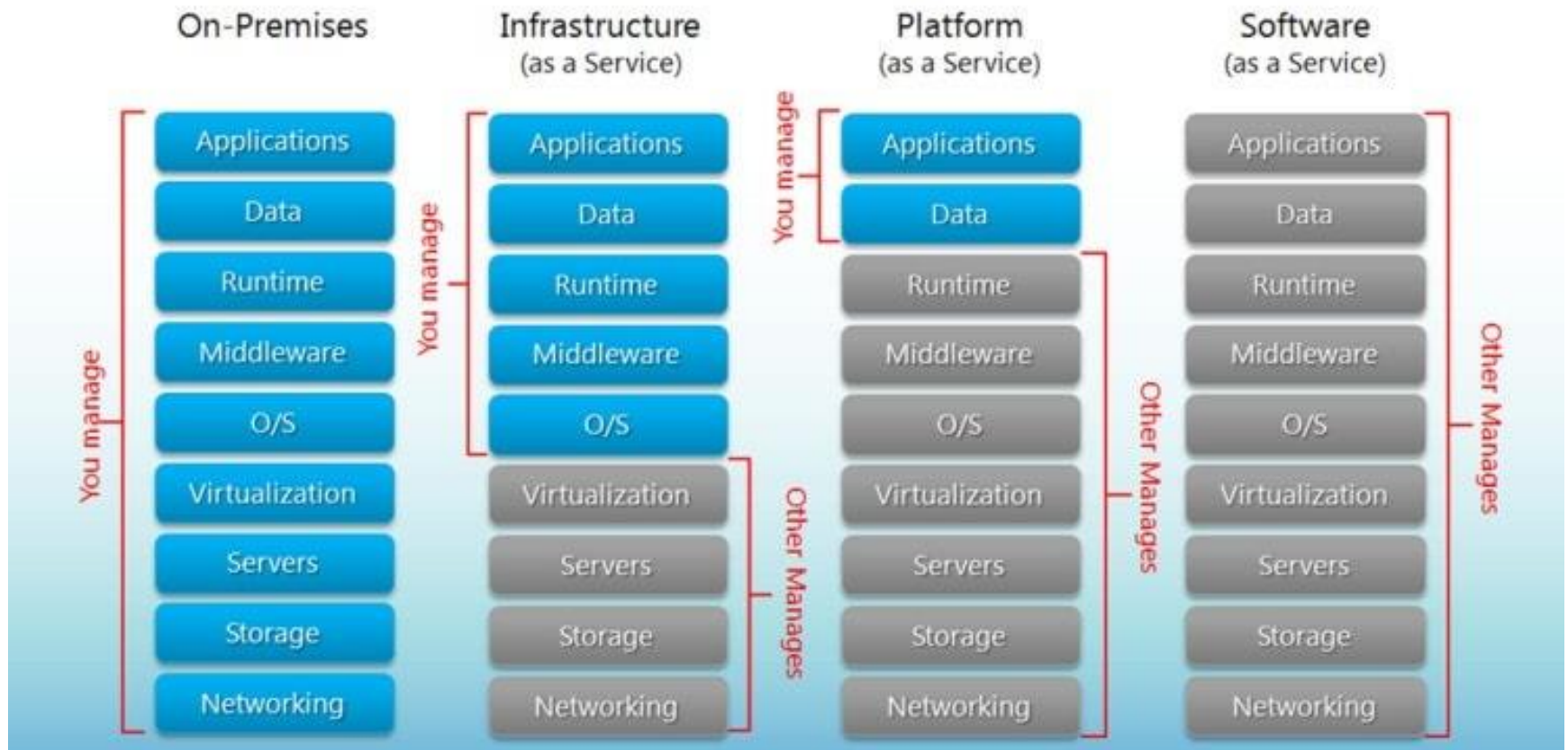
Examples of SaaS, PaaS, and IaaS

- SaaS examples: BigCommerce, Google Apps, Salesforce, Dropbox, MailChimp, ZenDesk, DocuSign, Slack, Hubspot.

- PaaS examples: AWS Elastic Beanstalk, Heroku, Windows Azure (mostly used as PaaS), Force.com, OpenShift, Apache Stratos, Magento Commerce Cloud.

- IaaS examples: AWS EC2, Rackspace, Google Compute Engine (GCE), Digital Ocean, Magento 1 Enterprise Edition*.
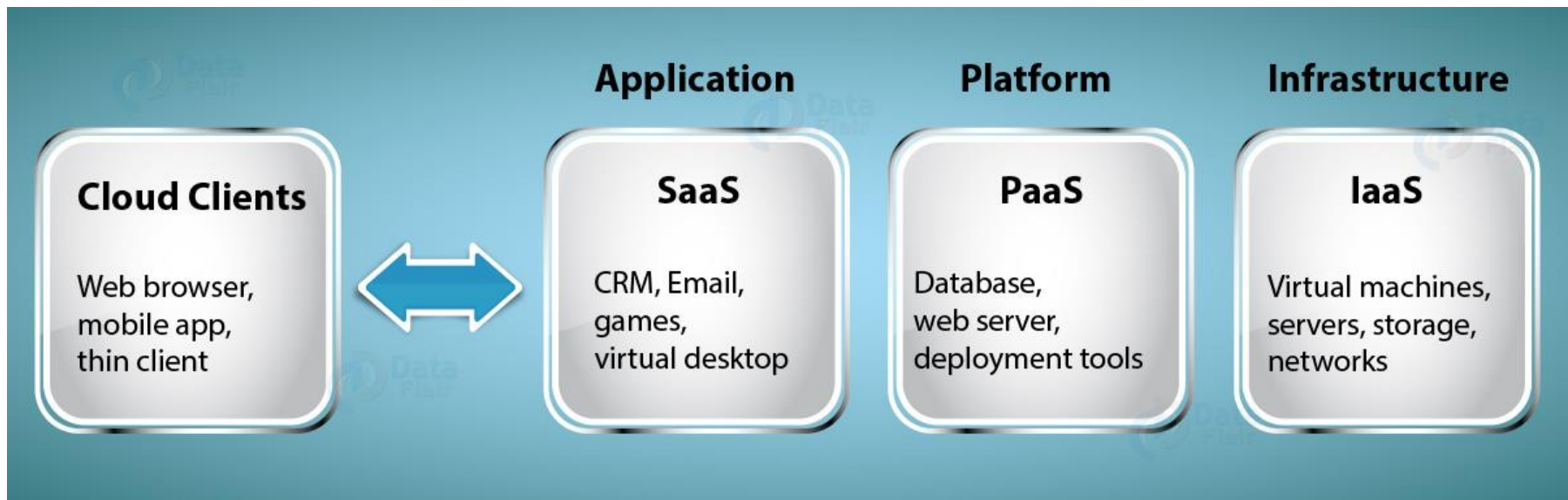
Cloud Computing Architecture

- **Cloud computing architecture** refers to the components and subcomponents required for cloud computing. These components typically consist of a front end platform (fat client, thin client, mobile),back end platforms (servers, storage), a cloud based delivery, and a network (Internet, Intranet, Intercloud). Combined, these components make up cloud computing architecture.
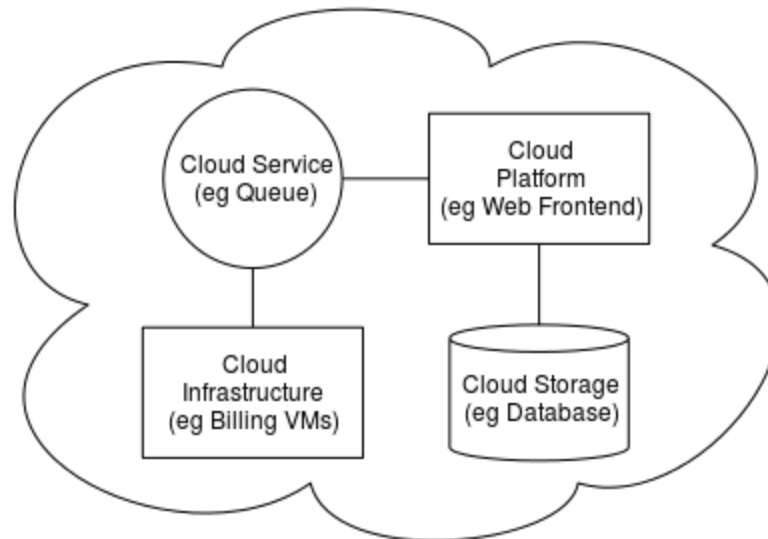
Security concerns for Cloud Computing

- One concern is that cloud providers themselves may have access to customer's unencrypted data- whether it's on disk, in memory or transmitted over the network.

- Some countries government may decide to search through data without necessarily notifying the data owner, depending on where the data resides, which is not appreciated and is considered as a privacy breach (Example Prism Program by USA).

- To provide security for systems, networks and data cloud computing service providers have joined hands with TCG (Trusted Computing Group) which is non-profit organization which regularly releases a set of specifications to secure hardware, create self-encrypting drives and improve network security. It protects the data from root kits and malware.

- As computing has expanded to different devices like hard disk drives and mobile phones, TCG has extended the security measures to include these devices. It provides ability to create a unified data protection policy across all clouds.

Cloud load-balancing

- Motivation:

    Rapid spikes in online traffic can challenge the best websites also. During online sales events, even a little interruption can cost lots of damage. Cloud manages online traffic by distributing workloads across multiple servers & resources. One characteristics of cloud technology is virtualized network access to a service - no matter where you access the service, it will direct you to the available resources.

Cloud load-balancing…

- Cloud load-balancing is the process of distributing workloads & computing resources within a cloud technology's environment. It also helps organizations & enterprises to manage workload demands by allocating resources among multiple systems or servers. Cloud load balancing also involves hosting the distribution of workload traffic that resides over the internet.

- High performance level of tasks can be achieved using this load balancing technique on a lower cost than traditional on-premises load-balancing technology. In addition to workload and traffic distribution, cloud technology's load balancing can also provide health check for Cloud applications.

Cloud load-balancing…

- A typical scheduling algorithm pseudo code for Load balancing is given below:

```
minmin()
{
Generate completion-time matrix
for each task in task-list
{
Search for Minimum completion time of matrix;
Assign task in repetitive mode;
update the Completion-time;
}
}
```

Cloud load-balancing…

- The Load-Balancing **Min Min** (LBMM) technique assigns sub-tasks to those nodes which require least amount of execution time.

- A session ticket is created by the load balancers so that related traffic from a client session can be properly routed to the same resource. Without this session record or persistence, a load balancer would not be able to correctly failover a request from one resource to another.

Cloud Cube Model

- **Cloud Cube Model**, designed and developed by **Jericho forum**. Which helps to categorize the cloud network based on the four-dimensional factor: Internal/External, Proprietary/Open, De-Perimeterized/Perimeterized, and Insourced/Outsourced.
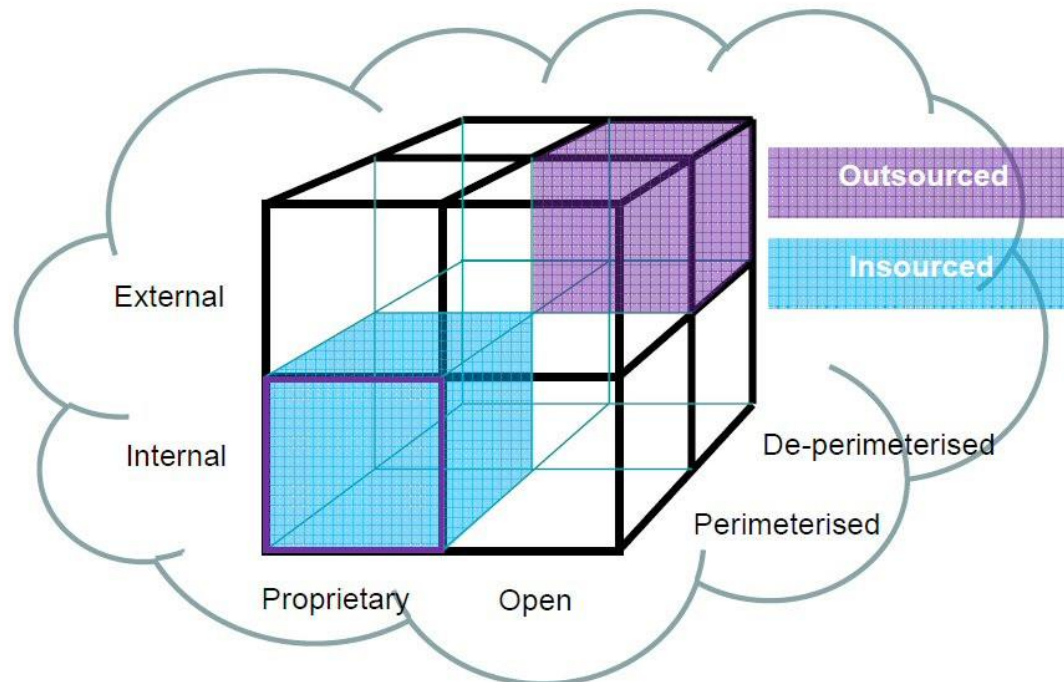
Cloud Cube Model…

- Cloud Cube model, helps to categorize the cloud network based on the four-dimensional factor. Their main focus is to protect and secure the cloud network. This cloud cube model helps to select cloud formation for secure collaboration.

- This model helps IT managers, organizations, and business leaders by providing the secure and protected network.

- Security is an important concern for cloud customers and most of the **cloud providers** understand it. The customer should also keep in mind, the selected cloud formation meets the regulatory and location requirements.

- They should also keep in mind that if cloud providers stop providing the services, where else they can move.

Dimensions of Cloud Cube Model

- Cloud Cube model has four dimensions to categorized cloud formations:
  - Internal/External
  - Proprietary/Open
  - De-Perimeterized/Perimeterized
 - Insourced/Outsourced Dimension

Internal/External

- The most basic cloud form is the **external and internal cloud form**. The external or internal dimension defines the physical location of the data. It acknowledges us whether the data exists inside or outside of your organization's boundary.

- Here, the data which is stored using a **private cloud** deployment will be considered internal and data outside the cloud will be considered external.
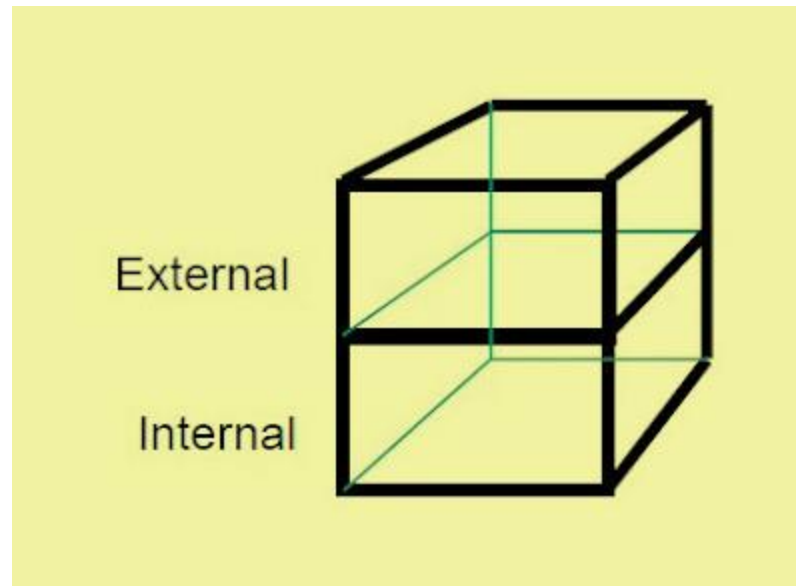
Proprietary/Open

- The second type of cloud formation is **proprietary and open**. The proprietary or open dimension states about the state of ownership of the **cloud technology** and interfaces. It also tells the degree of interoperability, while enabling data transportability between the system and other cloud forms.

- The **proprietary dimension** means, that the organization providing the **service is securing** and protecting the data under their ownership.

- The **open dimension** is using a technology in which there are more suppliers. Moreover, the user is not constrained in being able to share the data and collaborate with selected partners using the open technology.

Proprietary Open
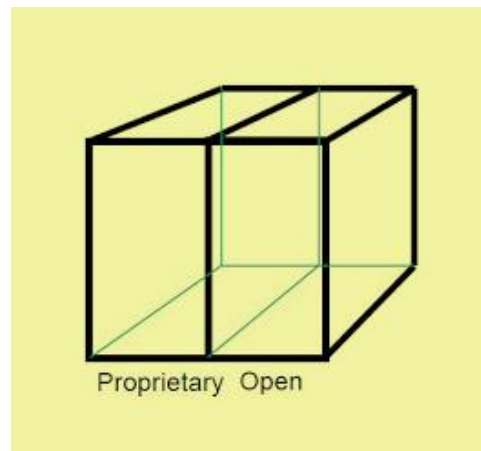
De-Perimeterized/Perimeterized

- The Perimeterised and De-perimeterized dimension tells us whether you are operating inside your traditional it mindset or outside it.

- **Perimeterized dimension** means, continuing to operate within the traditional it boundary, orphan signaled by network firewalls.

- With the help of VPN and operation of the virtual server in your own IP domain, the user can extend the organizations perimeter into external Cloud Computing domain. This means that the user is making use of the own services to control access.

- **De-perimeterized dimension** means the system perimeter is architected on the principles outlined in the Jericho forums commandments. In De-perimeterized dimension, the data will be encapsulated with metadata and mechanisms, which will further help to protect the data and limit the inappropriate usage.
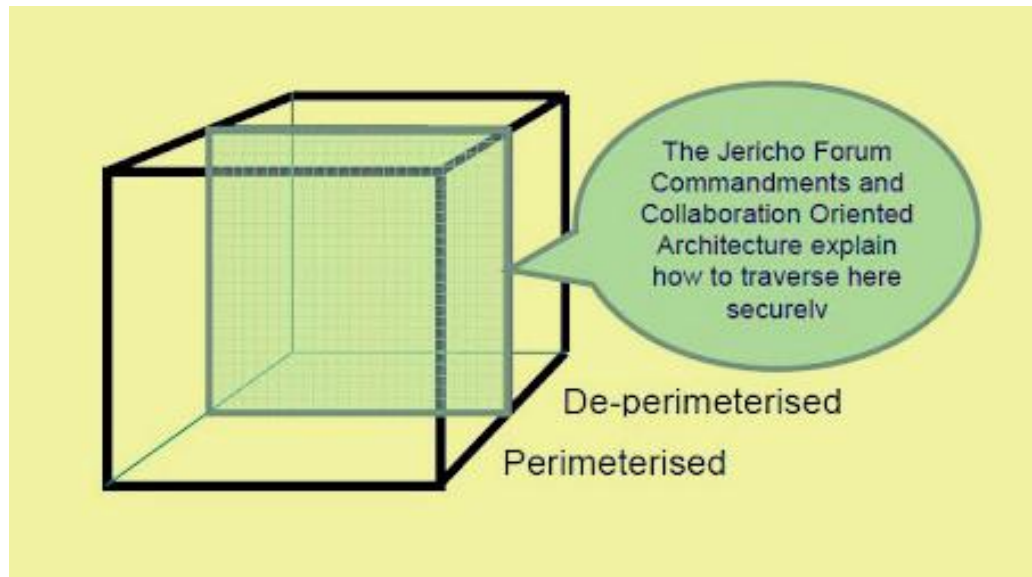
Insourced/Outsourced

- The **Insourced and outsourced dimensions** have two states in each of the eight cloud forms. In the *outsourced dimension* the services provided by the third party, whereas in the *insourced dimension* the services provided by the own staff under the control.

- In this few organizations that are traditional bandwidth software or hardware, providers will run fluently on becoming cloud service providers.

- The organizations which are seeking to procedure cloud services must have the ability to set legally binding collaboration agreement. In this, an organization should ensure that data is deleted from the service provider's Infrastructure.

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