Cloud Cost Management
&
Selection of Cloud Provider

Accessing the Cloud

Evaluating Cloud Computing Solution

Organisations should consider seven significant criteria to be able to select the right cloud computing solution for their business needs.

1. Location and Data Privacy
2. Network and Security
3. Service Level Agreements (SLA)
4. Software Stack and Storage
5. Vendor Lock-in and Legal Compliances
6. System Testing
7. Seasonal or Peak Loading

Location and Data Privacy

a. Most service providers would not be able to share the exact location of the data in the cloud.
b. Before hiring the cloud solution provider, organisations must look for the network and data diagrams to help understand the exact location for the data.
c. The provider should be able to give details on the data stored in the cloud, and the privacy levels offered by the cloud solution.
d. The provider needs to maintain transparency on who will access the data, and whether or not they will share the data with others.
e. Regular audits of the data location and accessibility should be conducted.

Network and Security

a. Cloud solutions are based on different layers like application layer, host layer, and network layer which make it complex and interconne cted in many ways.
b. The solution has to be secure at all levels in order to ensure that the enterprise data stored in the cloud remains protected.
c. Efforts need to be made to maintain the adequate level of application maturity, and build on its security levels.
d. For this, the provider's application and network level security need to be scrutinised. Know if the cloud solution offers application-layer firewall.
e. The application security should be integrated into the system at regular intervals.
f. The architecture and functional design of the cloud should be reviewed from a security perspective.

Software Stack and Storage

a. The cloud providers offer a certain technology and storage solution which becomes their unique selling point.
b. The focus for some providers is majorly based on the software stack they offer.
c. The application which is built using the software stack defined by the cloud will save a lot of time and cost.
d. With this solution, enterprises need not use the lower level infrastructure setup and configuration.
e. This software stack that is provided need the enterprises to follow certain best practices while designing and writing the apps, which in turn requires high levels of vendor lock in.

Software Stack and Storage

a. Along with software stack, storage is an important consideration.
b. How will the data be stored in the cloud, and made accessible to the enterprises?
c. Will the storage solution make way for remote access and virtualisation is another concern that should be addressed before hiring the cloud solution.

Vendor Lock-in and Legal Compliances

a. The application programming interface (API) offered by the cloud solution is an important criteria that one should evaluate.
b. This helps access the infrastructure, and performs operations like provisioning and de-provisioning servers.
c. The API is supported by multiple providers and vendors will reduce the lock-in, and help towards migration whenever needed.
d. The developer-vendor ecosystem will help enhance the services and capabilities of the cloud solution provider.
e. The API should be supported by majorly all vendors, and should comply with all the legal and security requirements as defined by the enterprises. API monitoring and management should be easy with the tools offered by the cloud solution provider.

System Testing

Testing all the 3 layers of the system offered by the cloud service provider is extremely important. How well the complete system functions can be understood by utilising the trial period / trial account for a specific unit. *E .g.: SalesForce offers a free trial to access all their* features for a limited period of 30 days.

Using the free trial, the organisation can easily understand how well the system performs under different loads. Depending on the type of services that an organisation wants to avail from a vendor, the resources would be allocated by the vendor depending on their service agreements for the specific time period (or) for a specific limit. Once the trial period gets over and all the components and features are tested positive, the organisat ion can opt for a subscription package for a specific time period as per the business requirements.

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Seasonal or Peak Loading

a. Whenever a cloud based application is accessed by millions of users at the same time, the load for the cloud servers increases.
b. The server should be capable enough to handle all the requests at the same time.
c. To handle all the requests, different cloud vendors have different solutions.
d. One of the most popular solution available in the market is Amazon's Elastic Load Balancing. Its part of Amazon Web Services (AWS).

a. Elastic Load Balancing handles all the users effectively by distributi ng the requests made by all the users across different virtual servers (technically called as Virtualisation).
b. The organisation which expects high traffic to its cloud based application has to create a load balancer(through easily customisin g the AWS settings) in one of more of its availability zones.
c. All the traffic to the application first hits the load balancer – which routes the traffic evenly to different virtual servers to process the r equests.

Expedia:

a. It is hosted on - and utilises Amazon web services.
b. There are millions of customers booking flight tickets and hotels through Expedia every single second.
c. All these booking requests come to the load balancers created by Expedia.
d. Then based on the availability of virtual servers, they are routed accordingly to be processed and tickets to be booked for the customer
e. Number of ticket bookings would be high especially during holiday and festival seasons like Diwali, Christmas, New Year etc., as lot of people travel to their natives.
f. AWS offers plenty of services that helps Expedia and many such organ isations handle seasonal loads.

Cost Benefit Analysis

a. One of the most significant benefits of cloud computing is cost savings.
b. It eliminates the need for upfront capital investment and also cuts down on costs such as space, power and personnel.
c. Five significant way in which cloud enables cost cutting are,

    a. The pay-as-go-model eliminates the need to spend on the purchase and maintenance of ideal servers.
    b. The cost of maintenance (personnel, power and space) is taken care.
    c. Allows businesses to focus on their core business function thus paving for better innovation and greater revenue.
    d. Eliminates the need to spend on additional resources as the business expands. Cloud model is highly scalable at fraction of cost.
    e. Cost for Back-up, restoration, depreciation and replacement of faulty hardware are taken care of by the service provider. This is a huge cost cutting measure from the traditional on premise infrastructure.

d. To ensure that the move to the cloud is truly a cost efficient choice, all hidden costs must be unravelled.

The key factors to consider while doing cost benefit analysis are as follows:

Cost Drivers	Traditional On-Premises Software	Cloud Application
Capital Expenses	• Purchase of software and hardware while commissioning the infrastructure • May require network infrastructureenhancements, facilities • Additional monitoring software, testing tools and security software may be required	• None • Pay-as-you-go subscription pricing • All inclusive: maintenance, support, training, and upgrades all hardware, networking, storage, database, administration
Design and Deployment	• May take months to deploy • Professional services can cost up to 3X the initial software purchase • Difficult for vendor to build best practices • Requires staff or contract labour to research, design, integrate, test, tune, launch, and train	• Deploy in weeks • Lower cost using consistent set of best practices
Ongoing Infrastructure	• Ongoing software maintenance, upgrades • Ongoing hardware replacement once every three years • Requires network monitoring and management tools • May require additional networking equipment and bandwidth to accommodate incremental traffic	• Vendor provides as part of subscription
Ongoing Ops, Training, Support	• Requires resources to operate, monitor, support, and upgrade the application • Need to hire, train and certify support personnel	• Vendor provides as part of subscription • There may be some training fees • Customer must ensure adequate Internet access and bandwidth

Measuring Actual Costs

a. Cloud computing is an investment made to reap some solid benefits for the long term.
b. To assess the value of this investment, the actual costs must be weighed against the benefits of the cloud outcomes.
c. A comparison must be drawn between hosting the infrastructure and applications on the cloud to doing so in the in-house data center.

d. The formula to calculate the cost of cloud deployment can be express ed as,

Cost of Cloud = Σ (Unit Cost of Cloud x (Revenue – Cost of Cloud))

(Unit cost of cloud refers to the cost of a machine instance per hour)

Forecasting, Load Balancing and Associated Costs

a. Applications that experience drastic demand fluctuations are best suited for the cloud.
b. The seasonal peak loads experienced by these applications often tend to be the most profitable and important time period for the business.
c. Therefore ensuring availability of the application through the peak load of additional requests becomes significant.

Forecasting, Load Balancing and Associated Costs

a. The use of load balancers in the cloud computing environment enables the optimum use of resources in the cost efficient manner.
b. Some cloud service providers offer enterprise class load balancing options while some limit their services to more simplistic ways of cloning new application instances.
c. Organisations must opt for the former service as these load balancers use a wide range of TCP optimisations to improve the capabilities of the server instead of launching more instances frequently.
d. This prevents the need to pay for the additional instances and save more for almost 25% of the additional requests.

Right Sizing

a. Restructuring the infrastructure of an organisation to derive maximum efficiency is called right sizing.
b. Right-sizing is appropriate for cases where workloads are predictable and follow a set cyclic pattern.
c. For instance, consider the banking sector, where transactions seem to hit the higher marks at the beginning and end of the month than mid way. In such cases, the infrastructure must be “right-sized” to accom modate the increased traffic without wasting too much idle capacity. Using the right tools and management processes helps optimising the cloud capacity and infrastructure costs.

Computing Total Cost of Ownership (TCO)

a. The total cost of ownership can be defined as a financial estimate that c overs the complete costs associated with a service throughout its lifetime . TCO of the cloud computing solution must include all overheads such as energy costs, cooling costs and cost of space and so on along with the major cloud deployment expenses.
b. It is a good practice to investigate the hidden costs involved in the pro cess and account every miscellaneous expense that may occur during the various stages of cloud deployment.

Subscription, Licensing Models and Cost Cutting

a. The subscription pricing model allows organisations to access the cloud service after an upfront payment is made.
b. This payment is based on the time period of the subscription, with longer the length, lower the price. However, this model is not suitable when the need for cloud resources is limited and organisations may tend to overpay.
c. Licensing in the cloud is also a tricky business where organisations must draw the cost difference between obtaining the license per user, per device or the enterprise license based on their usage needs.
d. The more characteristic pricing model for a cloud is the pay-per-use method where organisations pay only for whatever resources they use.
e. This helps cut costs to the maximum possible extent to all types of organisations as they only pay for those resources that they use.

Selecting the Right Scalable Application

a. Scalability is one of the most significant advantages of cloud comput ing. However the scalability of applications must not compromise with the quality of service offered by the cloud service provider.
b. An adverse impact on the performance of the cloud due to increased scalability may lower cost benefits.
c. The software features of the application and its design must be able to support the scalable architecture of the cloud.
d. When an application is not designed to use system resources efficiently it tends to underperform and demands much attention that required to achieve the expected level of performance.

Considerations for Selecting the Cloud Solution

The relevant factors that should be considered before moving to the cloud :

- Business considerations
- Data safety and security
- Interoperability, portability and integration
- Service level considerations
- Pricing and commercials
- Hosting and geographical considerations
- Contingency and recovery management
- Ethical and legal considerations
- Scalability and flexibility considerations

Business Considerations

a. Organisations move to the cloud to overcome certain inefficiencies and achieve higher operational parameters.
b. If the cloud vendor is too focused only on delivering technical outcomes, chances are that they may not really understand the business needs of an organisation.
c. Such a partnership that fails to deliver services streamlined to business objectives becomes meaningless.
d. If you are an organisation in a specific market vertical such as healthcare, banking or retail, it is recommended to choose a cloud service provider with vast experience and expertise in the same industry.

Data Safety and Security

a. Working with a trusted cloud service provider is the key to managing the various security issues that arise within the cloud.

b. While choosing a cloud service vendor, organisations must consider the following parameters:

- Regulatory Compliance
- Segregation of data in multitenant environments
- Data Recovery
- Access Privileges (Logical and Physical)
- Portability of data for business continuity
- Data Provenance
- Monitoring and Reporting
- Network security
- Data Encryption

c. The cloud service provider must address each of these criteria with solutions that are in adherence with the requirements of the business as well as the industry.

d. Additional evaluation measures that reflect the unique demands of an organisation must also be considered while selecting the right cloud service provider.

Interoperability, Portability and Integration

a. According to IEEE and ISO, interoperability can be defined as the ability of two or m ore systems or applications to exchange information and mutually use the i nformation that has been exchanged.
b. In cloud computing, interoperability can be understood as the capability of diverse s ystems to understand the application and interface, authentications, configurations, d ata formats etc., between public, private and hybrid clouds.
c. This capability helps all the systems to cooperate and interoperate to work s eamlessly.
d. Google authentication can be stated here as an excellent example for interoperability

Interoperability, Portability and Integration

a. The ability to move an entity between different systems seamless to be used on the target system is termed as Portability. The entity could be data or application.
b. Data stored in a particular database should be usable by many systems without the need to re-enter data.
c. This can be achieved by using a common data format for sharing between different services.
d. The syntax and semantics of the data are to be the same for ease of portability. XML is a common format used for data portability universally and it works really well with multiple systems.
e. Application portability can be defined as the ability to transfer a particular application and/or its components between different cloud services.
f. The application should have the ability to be recompiled and relinked to ensure ease of portability.
g. Application Program Interfaces (APIs) are universally used routines, protocols and tools to make application portability easier.

Interoperability, Portability and Integration

a. YouTube API is a classic example.
b. It lets developers and users integrate YouTube videos and relative functionalities into websites or applications seamlessly. Anybody with an embed link (provided by YouTube) can easily integrate the YouTube video in their website (or) blog.
c. It seamlessly ports all the necessary data and the application as a whole - across different hosting platforms.

Service Level Considerations

a. When determining the service level of a cloud vendor, there are essentially three factors to be considered
    a. Availability,
    b. Performance
    c. Reliability.
b. Availability of the service is determined by the number of “nines” mentioned in the SLA. Cloud service providers generally promise their availability by a guarante ed uptime of 99.9 or 99.999% uptime for an entire year.
c. While availability of the service is crucial, the speed at which it handles the busine ss-critical operations has a direct impact on the business outcome.
d. The reliability of a cloud vendor is determined through its transparency in operati ons. The cloud contract must include information pertaining to frequency of back ups, fault tolerance rate, provider response in case of outages and prior inform ation about scheduled downtimes for maintenance tasks.
e. While the exact location of the data centre may not be revealed, the country or region where the data resides must be known for regulatory and legal purposes.

Pricing Structure and Commercial Consideration

a. The pricing structure is one of the major deciding factors for start-ups as well as enterprises looking to move to the cloud.
b. A transparent cost structure that includes both one-time costs as well as ongoing costs must be presented by the cloud service provider.
c. The pricing offered by a vendor may depend upon a number of factors like security level, storage space and so on.
d. In any case the pricing must be flexible and must not carry any hidden costs.
e. A historical review of the prices offered by cloud service providers may offer some standard insights about their cost structure and organisations must always ensure that the comparison made between different vendors is strictly apples-to-apples.

Hosting Considerations

a. Do you have the budget for a private cloud?
b. Is your data suitable for the public infrastructure?
c. Is hybrid cloud the right solution for your storage needs?
d. There are several questions that arise while choosing the right cloud solution for your business needs.
e. Organisations must pick the cloud vendor based on their hosting expertise and ensure that it matched with their cloud requirements.
f. For instance, a large or medium sized enterprise looking to move its infrastructure to the cloud, can consider AWS, which is hands-down the best provider in this market space.
g. The same organisation must realise that for the expertise of PaaS platform is must look elsewhere.

Geographical Considerations

a. Your cloud service provider may carry your data across multiple locations in various geographic regions to mitigate risks such as localised outages, service latency and increased costs.
b. Enterprises must learn about the different locations of their data as the laws governing the storage and use of data vary with different jurisdictions.
c. Additionally, certain locations may also violate certain regulatory requirements and cause serious threats to data security.
d. Organisations that wish to limit the geographic location on any of the above basis must practice care while choosing their cloud service provider.
e. While contractual agreement and pre-engagement scrutinising are the common measures to limit the geographic boundaries of data, enterprises must obtain a clearer insight into the technical controls such as cryptography to ensure maximum protection against such considerations.

Contingency and Recovery Management

a. The cloud is very vulnerable and disaster recovery for applications hosted in the cloud must not be assumed as an inherent feature in the architecture of the cloud host.
b. Due diligence for disaster recovery (DR) must be implemented by the client orga nisation just like it would be performed for their own in-house infrastructure.
c. The cloud vendor must be prepared to share its literature that explains the vario us data protection solutions in detail.
d. The client must look for the DR features enclosed within the base price and have a thorough understanding of the vendor's backup capabilities.
e. Other significant elements to be considered while picking a cloud service provider are DR contingencies, location of the data centre, links with the recovery destinations and data centre hardening features.
f. In short, the cloud service provider must work hand-in-hand with the IT managers to assess risks, determine requirements and architect the desired DR solution at the least possible cost.

Ethical and Legal Considerations

a. Did you know that the data hosted in the cloud can be scrutinised directly by the government for regulatory and compliance issues?
b. Did you know that your clients can get the lawsuits flying for the failure of security and privacy promises made by your cloud service provider?
c. Cloud computing comes with significant ethical and legal considerations and organisations must acknowledge them to have a smooth relationship with the service provider and to ensure there is no financial loss in the form of legal penalties.

Scalability and Flexibility

a. With time organisations grow and so do their storage needs and number of IT staff.
b. The cloud service provider must be able to scale up to accommodate the additional storage requirements and add the new users into the system with no difficulty.
c. Alternatively, the services must also be able to scale down resources when the organisation is passing through a lull.
d. Such dynamic scaling of resources makes businesses highly agile in the competitive environment.
e. Every workload within an organisation is unique and demands a different configuration and delivery parameters.
f. The right cloud service provider must be able to provide a large range of options pertaining to security, resilience as well as performance such that the organisation can customise its needs and pay the cost of usage at the workload level.

Understanding Best Practices used in selection of Cloud service and providers

Performance

a. One of the main concerns for enterprises that are considering cloud computing is performance.
b. Achieving high-speed delivery of applications in the cloud is a multifaceted challenge that requires a holistic approach and an end-to-end view of the application request-response path.
c. Performance issues include the geographical proximity of the application and data to the end user, network performance both within the cloud and in-and-out of the cloud and I/O access speed between the compute layer and the multiple tiers of data stores.

Technology stack

a. Several cloud providers have focused their services on a particular software stack. This typically moves them from being Infrastructure as a Service (IaaS) providers to the realm of Platform as a Service (PaaS).
b. As one would expect, the different stack-specific clouds align with the most popular software stacks out there.
c. Examples include
    a. Heroku and Engine Yard for Ruby on Rails;
    b. VMforce and Google App Engine (GAE) for Java/Spring (GAE also support s Python),
    c. PHP Fog for PHP
    d. Microsoft's Windows Azure for .NET.
d. If your application is built using one of these stacks, you may want to consider these cloud platforms. They can offer tremendous savings in terms of time and expense by shielding you from having to deal with lower level infrastructure setup and configuration. The flip side is that they often require developers to follow certain best practices in architecting and writing their apps, which creates a higher degree of vendor lock-in.

Service-level agreements and reliability

a. Some cloud providers offer guarantees for higher levels of service as a way to separate themselves from the pack. Ex. Rackspace
b. SLAs are often merely an indication of the consequences when the service fails and not the service's actual reliability . Ex GoGrid
c. Although the SLA is a good indicator of any provider's level of commitment, knowing the real uptime levels of a particular cloud provider is a trickier proposition.
d. Most vendors have a status page that acts as a dashboard for the health of their services, but these generally display only stats from a few days ago at the earliest.
e. To get actual long-term numbers for reliability and availability, it's better to rely on customer testimonials and comparison services such as CloudSleuth and CloudHarmony.

APIs: Lock-in, community and ecosystem

a. Another critical aspect of selecting a cloud provider is the application programming interface (API) it exposes for accessing the infrastructure and performing operations such as provisioning and de-provisioning servers.
b. The API is important in a number of ways:
c. First, an API that is supported by multiple providers and vendors reduces lock-in because migration from one provider to another -- or simultaneously working with multiple providers -- requires less change to the application and is, therefore, easier.
d. Second, an API that is widely supported by a community of developers and vendors has an entire ecosystem around it of complementary services and capabilities.
e. The APIs offered by Amazon Web Services (AWS) and the various VMware cloud of ferings have large ecosystems built around them, which includes tools for governance (such as enStratus), monitoring and management (such as Cloudkick and RightScale) and a slew of other services that complete their cloud service.

Security and compliance

a. Two of the biggest barriers for companies considering cloud computing continue to be security and compliance.
b. The real concern for enterprises is not actually security threats but rather their inability to achieve compliance with security-related standards such as PCI.
c. In response, many cloud providers are now touting their security and compliance chops with SAS-70 Type II audits, security white papers and other measures.
d. Banking on the opportunity, cloud provider Logicworks, has dubbed its offering the Compliant Cloud and has recently announced the Level 1 PCI accreditation of its cloud.

Cost

a. A straightforward way to compare cloud providers would appear to be cost.
b. The problem is that there is no consistency among providers in regards to the resources customers actually receive and pay for.
c. Providers offer virtual machines(VMs) that vary widely in memory capacity, CPU clock speed and other features.
d. Furthermore, the units that are actually provided to customers are often virtualized, creating even further confusion as to what the customer is actually getting and how it might be affected by other customers on the same cloud.
e. Amazon has EC2 Compute Units, Heroku offers Dynos and other vendors have created their own measurement units. The only truly reliable way to measure the cost-performance of different cloud providers at this point is to conduct an experiment with the same application or prototype on multiple providers and compare the results.

Clouding the Standards and Best Practices Issue

Standards are important for the cloud in a number of areas:

- ✓ Interoperability
- ✓ Portability
- ✓ Integration
- ✓ Security

Interoperability

a. *Interoperability refers to cloud users being able to take their tools, applications,* virtual images, and so on and use them in another cloud environment without having to do any rework.
b. For example if one application runs in one environment and you need that application to operate with a partner's application in another cloud environment.
c. If the right interoperability standards are in place, you can do this without needing multiple versions of this application.
d. Simple Object Access Protocol (SOAP), Representational State Transfer (REST), and Atom Syndication Format and Atom Publishing Protocol (both standards referred to as Atom) are all examples of widely used interoperability standards and protocols.

Portability

Portability lets you take one application or instance running on one vendor's implementation and deploy it on another vendor's implementation. For example, you might want to move your database or application from one cloud environment to another.

Integration

a. By *integration, we generally think of combining various hardware* and software components together to create something.
b. The same idea applies in the cloud. One example of integration: easily integrating your data with a Software as a Service application. This is an example of taking some of your internal IT capability and integrating it into the cloud environment.
c. Portability and integration become major issues when cloud vendors have different platforms.
d. This can lead to vendor lock-in, which means that moving to another cloud provider is so difficult that you don't even bother trying.

Security

a. Cloud security make sure that the right controls, procedures, and technology are in place to protect your corporate assets.
b. Your organization has invested a lot internally to protect your assets, and it's reasonable to assume that your cloud provider should do the same.
c. Cloud security standards are a set of processes, policies, and best practices that ensure that the proper controls are placed over an environment to prevent application, information, identity, and access issues (to name a few).
d. Two organizations that are very active in this area are the Cloud Security Alliance and a think tank called the Jericho Forum.

Standards Organizations and Groups

a. Cloud Security Alliance
b. Distributed Management Task Force (DMTF)
c. National Institute of Standards and Technology (NIST)
d. Open Cloud Consortium (OCC)
e. Open Grid Forum (OGF)
f. The Object Management Group (OMG)
g. Storage Networking Industry Association (SNIA)
h. Cloud Computing Interoperability Forum (CCIF)
i. Vertical groups

Cloud Security Alliance

a. The Cloud Security Alliance (www.cloudsecurityalliance.org) formed in late 2008 when cloud security became important in user's minds.
b. Its founding members include PGP, QualSys, Zscaler, and the Information Systems Audit and Control Association (ISACA).
c. The CSA's goal is to promote a series of best practices to provide security assurance in cloud computing. Its objectives include

    a. Promoting understanding between users and providers of cloud computing regarding security requirements
    b. Researching best practices for cloud security
    c. Launching awareness campaigns about cloud security solutions
    d. Creating consensus lists of issues and guidance for cloud security assurance

d. The Cloud Security Alliance recently published "Guidance for Critical Areas of Focus in Cloud Computing," which is available at www.cloudsecurityallia nce.org/guidance.

Distributed Management Task Force (DMTF)

a. The DMTF (www.dmtf.org) has been around for about 15 years.
b. In the cloud space, it focuses on IaaS (Infrastructure as a Service), and providing standards that enable IaaS to be a flexible, scalable, high-performa nce infrastructure. Part of this is to try to separate the infrastructure from the applications.
c. Members include pretty much every major hardware, systems software, and networking vendor, as well as smaller companies and at least 50 universities.
d. The DMTF is the group that developed the OVF standard that is formally known as DSP0243 Open Virtualization Format (OVF) V1.0.0. It describes an open, secure, and portable format for packaging and distribution of software that will be run in virtual machines.
e. The DMTF has also launched the Open Cloud Standards Incubator, which will focus on standardizing interactions between cloud environments by developing cloud resource management protocols, packaging formats, and security mechanisms to facilitate interoperability.
f. Of specific interest are specifications that can facilitate interoperability between public and private clouds.

National Institute of Standards and Technology (NIST)

a. NIST (www.nist.gov), which has been around since 1901, is a nonregulatory federal agency that is part of the U.S. Department of Commerce.
b. Its goal is to promote innovation and U.S. competitiveness by advancing standards, measurement science, and technology.
c. NIST has a hand in standards everywhere, from the fire-related standards that your mattress had to pass to the auto emissions your car must (not) pass on the road.
d. Recently, NIST has formed a cloud computing team to help federal agencies understand cloud computing and to determine the best way to secure those agencies implementing the technology.
e. The team is creating a special publication that includes information for the government agencies around various cloud models, security issues including application security, cloud monitoring, and service level agreements, among others.

Open Cloud Consortium (OCC)

a. The OCC (www.opencloudconsortium.org) was formed in 2008.
b. One of its goals is to support the development of standards for cloud computing and frameworks for interoperating between clouds.
c. Members include Cisco and Yahoo as well as a number of universities including Northwestern.
d. The OCC has a number of working groups. Two in particular deal with cloud standards:
    a. **Working Group on Standards and Interoperability for Clouds That Provide On-Demand Computing Capacity:** The focus for this group is on developing standards for interoperating clouds that provide on demand computing capacity and interoperability between storage clouds and compute clouds.
    b. **Working Group on Information Sharing, Security, and Clouds:** This group focuses on standards and standards-based architecture for sharing information between clouds. The emphasis is on clouds belonging to different organizations and subject to different policies. The group is also examining security in the cloud.

Open Grid Forum (OGF)

a. The OGF (www.ogf.org) is an open community that focuses on driving the adoption and evolution of distributed computing.
b. This includes everything from distributed high-performance computing resources to horizontally scaled transactional systems supporting SOA as well as the cloud.
c. It consists of more than 400 companies in 50 countries, including AT&T and eBay.
d. The Open Cloud Computing Interface Group (OCCI), formed in 2009, is a working group within the OGF that focuses on the creation of an API for interfacing infrastructure cloud facilities.
e. The group is looking to deliver an API specification for remote management of cloud infrastructure that enables common tasks such as provisioning and managing virtual environments.
f. It will also define these infrastructure cloud services.

The Object Management Group (OMG)

a. The OMG (www.omg.org) is an international group focused on developing enterprise integration standards for a wide range of industries including government, life sciences, and healthcare.
b. The group provides modelling standards for software and other processes
c. These include embedded and specialized systems and architecture driven modernization and middleware.
d. Its task forces have developed modelling standards including the *Unified Modeling Language (UML) and Model Driven Architecture (MDA).*
e. OMG has recently begun efforts focusing on modelling deployment of applications and services on clouds to enable interoperability, portability, and reuse.

Storage Networking Industry Association (SNIA)

a. The SNIA (www.snia.org) has focused for more than ten years on developing storage solution specifications and technologies, global standards, and storage education.
b. This organization's mission, according to the SNIA members, is "to promote acceptance, deployment, and confidence in storage related architectures, systems, services, and technologies, across IT and business communities".
c. Very recently, the SNIA created the Cloud Storage Technical Work group to develop SNIA Architecture and best practices related to system implem entation of cloud storage technology.
d. It will act as a technical entity to help SNIA to identify and develop cloud standards for cloud storage.
e. It also will produce a set of standards interface specifications and document system-level requirements under the guidance of the SNIA Technical Council and in cooperation with the SNIA Strategic Alliances Committee.

Cloud Computing Interoperability Forum (CCIF)

a. The Cloud Computing Interoperability Forum (CCIF at www.ccif.org) provides discussion forums to create a cloud computing ecosystem where organizations can work together for wider adoption of cloud computing technology and services.
b. A major focus is on creating a framework that enables two or more cloud platforms to exchange information in a unified way.
c. it focuses on building community consensus, exploring emerging trends, and advocating best practices/reference architectures for the purposes of standardized cloud computing.

Vertical groups

a. *Vertical industry groups — groups comprised of members from a particular industry such as* technology and retail — are also beginning to look at cloud standards.
b. Examples include
    i. **Telemanagement Forum (TM Forum):**
        i. This large group has more than 700 members in 75 countries including service providers, cable and network operators, software suppliers, equipment suppliers, and systems integrators.
        ii. Its goal is to improve business effectiveness for service providers and their suppliers.
        iii. The TM Forum serves the information, communications, and entertainment industries.
        iv. It produces educational information such as industry research, road maps, best practices, training, and standards.
        v. Recently, it began working in the telecommunications initiative for cloud computing.

Vertical groups

ii. **Association for Retail Technology Standards (ARTS):**
   i. This group is part of the National Retail Federation and its goal is to create an open environment where retailers and technology vendors can work together to create international retail technology standards.
   ii. This includes the Unified POS (a specification for point-of-sale, or POS, device interfaces).
   iii. Recently, this group also started looking at researching this space and developing white papers to address cloud issues for this vertical.

THANK YOU