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Cloud Computing

Cloud Computing

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Cloud is a demand resources or services over Internet scale and reliability of a data center.

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

It describes a new supplement, consumption and delivery model for IT services based on Internet, and it typically involves the provision of dynamically scalable and often virtualized resources as a service over the internet.

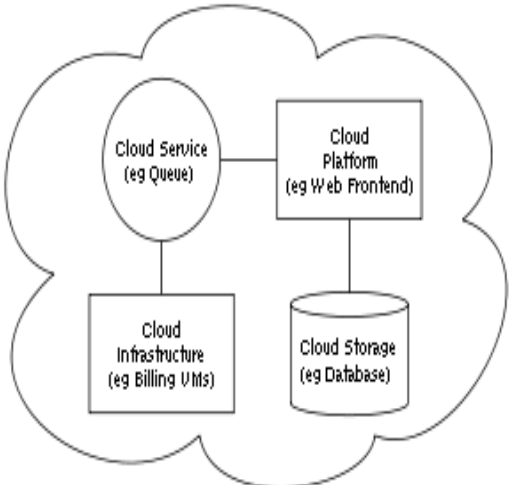
It is a growing trend in information technology as organizations look for ways to save money and add flexibility to their operations. Cloud computing, while still an evolving service, provides on-demand network access to a shared pool of computing resources such as networks, servers, storage and applications. The pooling of resources allows the provider to rapidly scale to meet changing customer demands. The service is typically provided through a large data center. Cloud computing can be divided into three types: Software as a Service, Platform as a Service, and Infrastructure as a Service.

Characteristic of cloud computing:

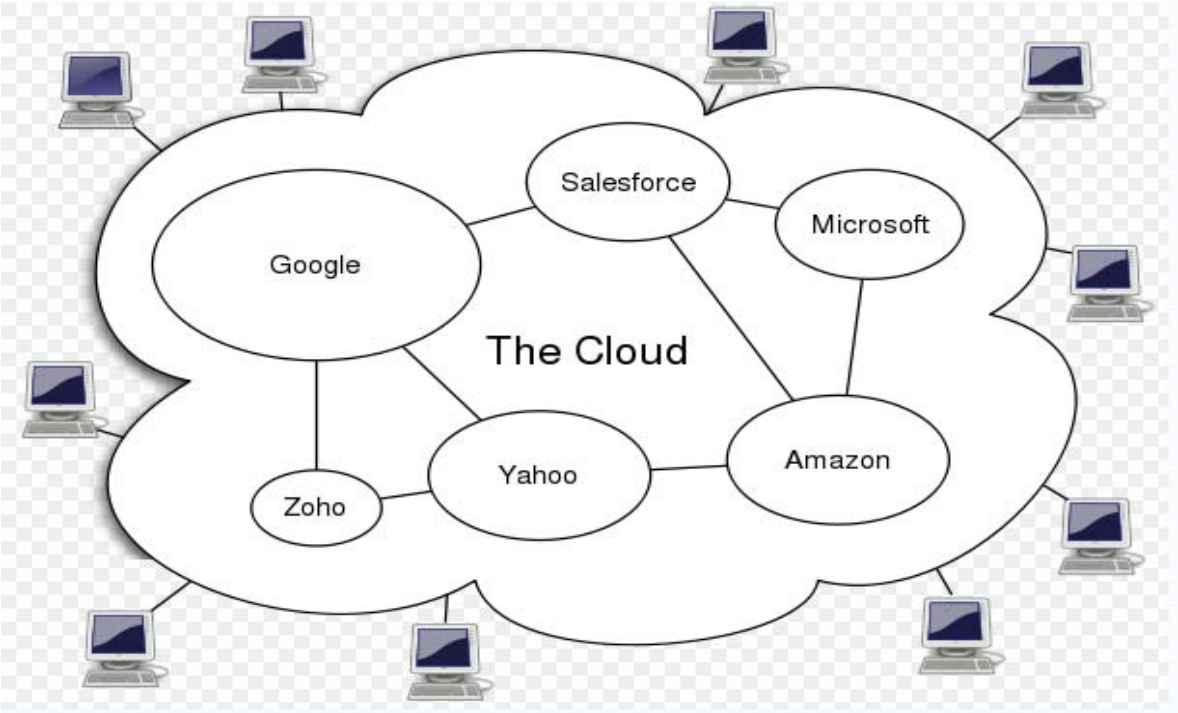
- **Virtual:** Software, database, Web servers, operating systems, storage and networking as virtual servers.
- **Incremental Scalability:** Cloud environments allow users to access additional compute resources on-demand in response to increased application loads.
- **Agility:** As a shared resource, the cloud provides flexible, automated management to distribute the computing resources among the cloud's users.
- **Reliability and Fault-Tolerance:** Cloud environments take advantage of the built-in redundancy of the large numbers of servers that make them up by enabling high levels of availability and reliability for applications that can take advantage of this.
- **Service-oriented:** The cloud is a natural home for service-oriented applications, which need a way to easily scale as services get incorporated into other applications.
- **Utility-based:** Users only pay for the services they use, either by subscription or transaction-based models.
- **Shared:** By enabling IT resources to be consolidated, multiple users share a common infrastructure, allowing costs to be more effectively managed without sacrificing the security of each user's data.
- **SLA-driven:** Clouds are managed dynamically based on service-level agreements that define policies like delivery parameters, costs, and other factors.
- **APIs:** Because clouds virtualize resources as a service they must have an application programming interface (API).

Architecture of cloud computing:

Cloud architecture, the system architecture of the software systems involved in the delivery of cloud computing, typically involves multiple cloud components communicating with each other over application programming interfaces, usually web services. This resembles the Unix philosophy of having multiple programs each doing one thing well and working together over universal interfaces. Complexity is controlled and the resulting systems are more manageable than their monolithic counterparts.



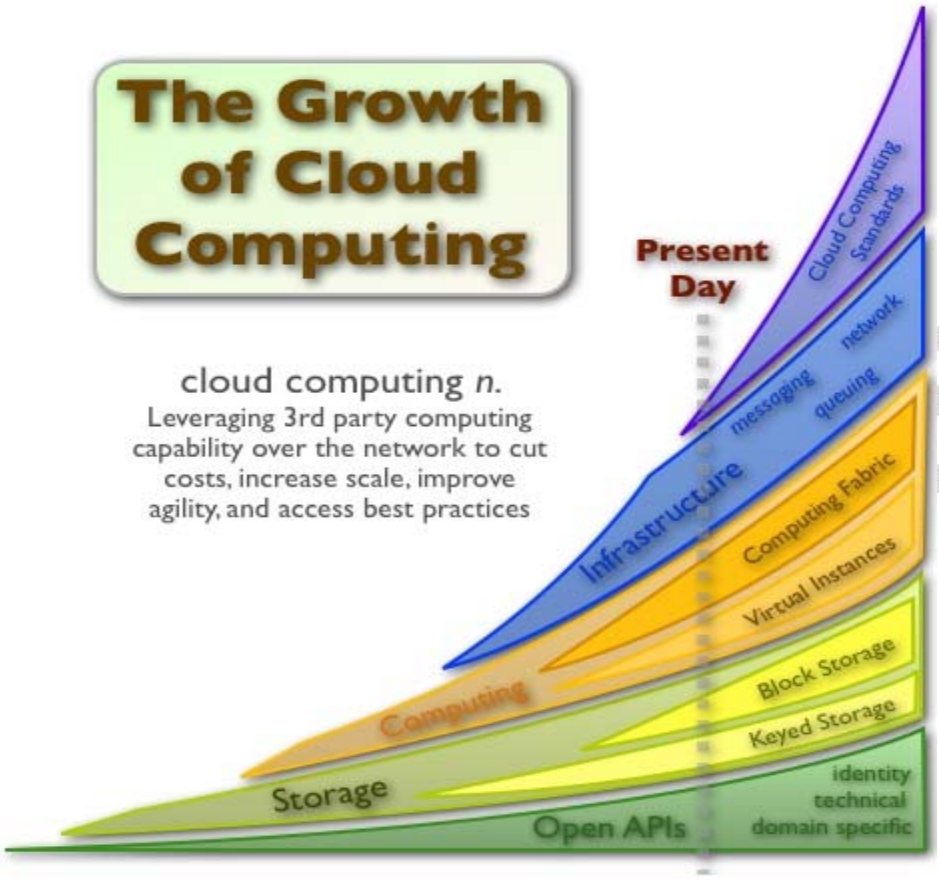
Cloud computing logical diagram:



Growth of cloud computing:

Cloud computing comes into focus only when you think about what IT always needs: a way to increase capacity or add capabilities on the fly without investing in new infrastructure, training new personnel, or licensing new software. Cloud computing encompasses any subscription-based or pay-per-use service that, in real time over the Internet, extends its existing capabilities.

Cloud computing is at an early stage, with a motley crew of providers large and small delivering a slew of cloud-based services, from full-blown applications to storage services to spam filtering. Yes, utility-style infrastructure providers are part of the mix, but so are SaaS (software as a service) providers such as Salesforce.com. Today, for the most part, IT must plug into cloud-based services individually, but cloud computing aggregators and integrators are already emerging.



Key features:

- Agility improves with users' ability to rapidly and inexpensively re-provision technological infrastructure resources.
- Cost is claimed to be greatly reduced and capital expenditure is converted to operational expenditure. This ostensibly lowers barriers to entry, as infrastructure is typically provided by a third-party and does not need to be purchased for one-time or infrequent intensive computing tasks. Pricing on a utility computing basis is fine-grained with usage-based options and fewer IT skills are required for implementation (in-house).
- Device and location independence enable users to access systems using a web browser regardless of their location or what device they are using (e.g., PC, mobile). As infrastructure is off-site (typically provided by a third-party) and accessed via the Internet, users can connect from anywhere.
- Multi-tenancy enables sharing of resources and costs across a large pool of users thus allowing for:
    - Centralization of infrastructure in locations with lower costs (such as real estate, electricity, etc.)
    - Peak-load capacity increases (users need not engineer for highest possible load-levels)
    - Utilization and efficiency improvements for systems that are often only 10–20% utilized.

- Reliability is improved if multiple redundant sites are used, which makes well designed cloud computing suitable for business continuity and disaster recovery. Nonetheless, many major cloud computing services have suffered outages, and IT and business managers can at times do little when they are affected.
- Scalability via dynamic ("on-demand") provisioning of resources on a fine-grained, self-service basis near real-time, without users having to engineer for peak loads. Performance is monitored and consistent and loosely coupled architectures are constructed using web services as the system interface. One of the most important new methods for overcoming performance bottlenecks for a large class of applications is data parallel programming on a distributed data grid.
- Security could improve due to centralization of data, increased security-focused resources, etc., but concerns can persist about loss of control over certain sensitive data, and the lack of security for stored kernels. Security is often as good as or better than under traditional systems, in part because providers are able to devote resources to solving security issues that many customers cannot afford. Providers typically log accesses, but accessing the audit logs themselves can be difficult or impossible. Furthermore, the complexity of security is greatly increased when data is distributed over a wider area and / or number of devices.
- Maintenance cloud computing applications are easier to maintain, since they don't have to be installed on each user's computer. They are easier to support and to improve since the changes reach the clients instantly.
- Metering cloud computing resources usage should be measurable and should be metered per client and application on daily, weekly, monthly, and annual basis. This will enable clients on choosing the vendor cloud on cost and reliability (QoS).

Layers of cloud computing:

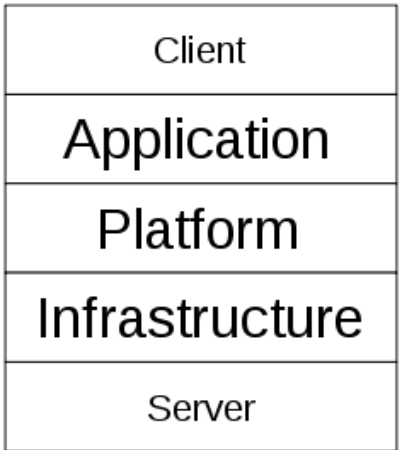
Client:

A cloud client consists of computer hardware and/or computer software that relies on cloud computing for application delivery, or that is specifically designed for delivery of cloud services and that, in either case, is essentially useless without it. Examples include some computers, phones and other devices, operating systems and browsers.

Application:

Cloud application services or "Software as a Service (SaaS)" deliver software as a service over the Internet, eliminating the need to install and run the application on the customer's own computers and simplifying maintenance and support. Key characteristics include:

- Network-based access to, and management of, commercially available (i.e., not custom) software
- Activities that are managed from central locations rather than at each customer's site, enabling customers to access applications remotely via the Web
- Application delivery that typically is closer to a one-to-many model (single instance, multi-tenant architecture)



than to a one-to-one model, including architecture, pricing, partnering, and management characteristics

- Centralized feature updating, which obviates the need for downloadable patches and upgrades.

Following are the features of SaaS.

- No hardware or software to manage
- Service delivered through a browser
- Customers use the service on demand
- Instant Scalability

SaaS is used for the following conditions:

- Your current CRM package is not managing the load or you simply don't want to host it in-house. Use a SaaS provider such as Salesforce.com
- Your email is hosted on an exchange server in your office and it is very slow. Outsource this using Hosted Exchange.

Platform:

Cloud platform services or "Platform as a Service (PaaS)" deliver a computing platform and/or solution stack as a service, often consuming cloud infrastructure and sustaining cloud applications. It facilitates deployment of applications without the cost and complexity of buying and managing the underlying hardware and software layers.

Following are the features of PaaS.

- Platforms are built upon Infrastructure, which is expensive
- Estimating demand is not a science!
- Platform management is not fun!

PaaS is used for the following conditions:

- You need to host a large file (5Mb) on your website and make it available for 35,000 users for only two months duration. Use Cloud Front from Amazon.
- You want to start storage services on your network for a large number of files and you do not have the storage capacity. Use Amazon S3.

Infrastructure:

Cloud infrastructure services or "Infrastructure as a Service (IaaS)" delivers computer infrastructure, typically a platform virtualization environment as a service. Rather than purchasing servers, software, data center space or network equipment, clients instead buy those resources as a fully outsourced service. The

service is typically billed on a utility computing basis and amount of resources consumed (and therefore the cost) will typically reflect the level of activity. It is an evolution of virtual private server offerings.

Following are the features of IaaS.

- A platform virtualization environment
- Computing resources, such as storing and processing capacity.
- Virtualization taken a step further

IaaS is used for the following conditions:

- You want to run a batch job but you don't have the infrastructure necessary to run it in a timely manner. Use Amazon EC2.
- You want to host a website, but only for a few days. Use Flexi scale.

Server:

The servers' layer consists of computer hardware and/or computer software products that are specifically designed for the delivery of cloud services, including multi-core processors, cloud-specific operating systems and combined offerings.

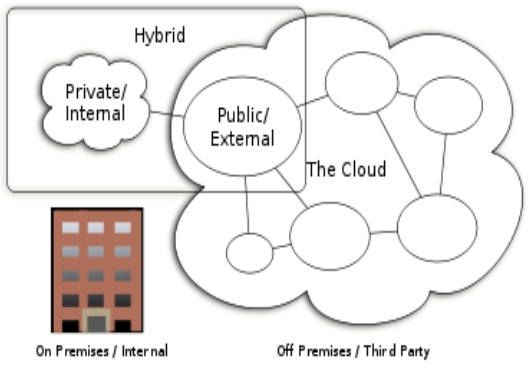
Deployment models:

Public cloud:

Public cloud or external cloud describes cloud computing in the traditional mainstream sense, whereby resources are dynamically provisioned on a fine-grained, self-service basis over the Internet, via web applications/web services, from an off-site third-party provider who shares resources and bills on a fine-grained utility computing basis.

Community cloud:

A community cloud may be established where several organizations have similar requirements and seek to share infrastructure so as to realize some of the benefits of cloud computing. With the costs spread over fewer users than a public cloud (but more than a single tenant) this option is more expensive but may offer a higher level of privacy, security and/or policy compliance. Examples of community cloud include Google's "Gov Cloud".



Cloud Computing Types

Hybrid cloud:

A hybrid cloud environment consisting of multiple internal and/or external providers "will be typical for most enterprises". By integrating multiple cloud services users may be able to ease the transition

to public cloud services while avoiding issues such as PCI compliance.

Another perspective on deploying a web application in the cloud is using Hybrid Web Hosting, where the hosting infrastructure is a mix between Cloud Hosting for the web server, and Managed dedicated server for the database server.

Private cloud:

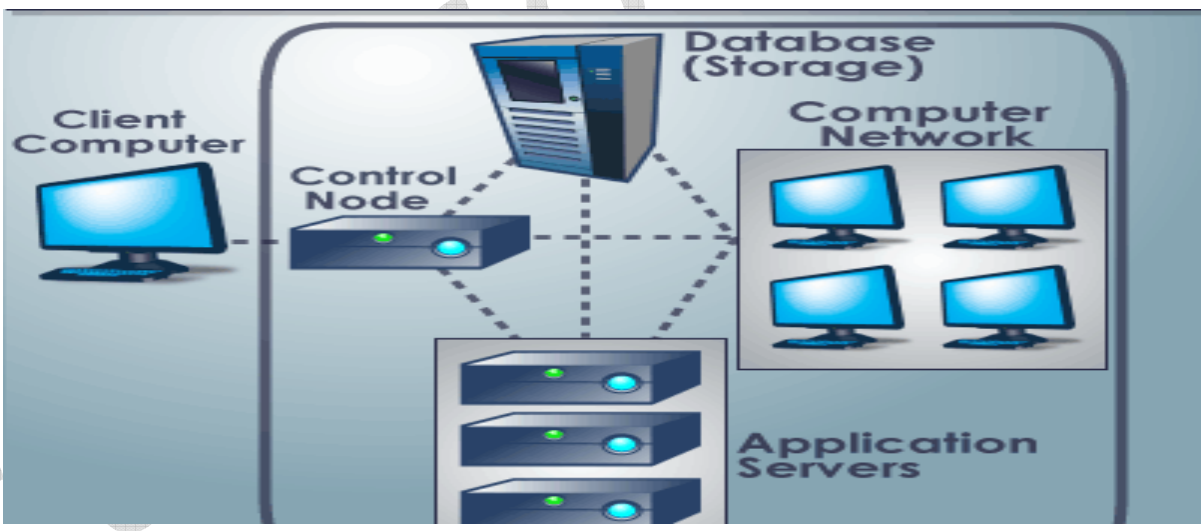
The concept of a Private Computer Utility was first described by Douglas Parkhill in his 1966 book "The Challenge of the Computer Utility". The idea was based upon direct comparison with other industries (e.g. the electricity industry) and the extensive use of hybrid supply models to balance and mitigate risks.

Private cloud and internal cloud have been described as neologisms, however the concepts itself pre-dates the term cloud by 40 years. Even within modern utility industries, hybrid models still exist despite the formation of reasonably well functioning markets and the ability to combine multiple providers.

Some vendors have used the terms to describe offerings that emulate cloud computing on private networks. These (typically virtualisation automation) products offer the ability to deliver some benefits of cloud computing whilst mitigating some of the pitfalls. These offerings capitalise on data security, corporate governance, and reliability concerns during this time of transition from a product to a functioning service based industry supported by competitive marketplaces.

They have been criticized on the basis that users "still have to buy, build, and manage them" and as such do not benefit from lower up-front capital costs and less hands-on management, essentially "[lacking] the economic model that makes cloud computing such an intriguing concept".

How cloud computing works:



Security concerns with cloud computing:

There are security and privacy concerns that must be considered before moving to cloud computing, including the following:

- **Vendor Security:** Cloud computing customers rely on providers to implement appropriate security measures to protect the confidentiality, integrity, and availability of data. Be wary of providers who are reluctant to share details of their security architecture/practices with customers.

- **Isolation/Segregation:** Users access cloud computing resources via a virtual machine hosted on an unknown physical machine. The physical machine may be shared with other users. Providers must ensure that multiple customers do not interfere with each other, maliciously or unintentionally.

- **Data Location:** Providers may have data centers located in other countries. Be sure your vendor contract stipulates any restrictions you may have on the physical location of where your data is stored.

- **Management Interface:** Customers access the cloud management interface via the Internet, thus increasing exposure to potential attack.

- **Reputation Sharing:** Bad behavior by one cloud customer may impact others using the cloud. For example a customer engaging in spamming may cause a common cloud IP address to be blacklisted.

- **Provider Viability:** What happens to your organization's applications and data in the event that the provider goes out of business?

- **Compliance:** Placement of data in the cloud does not eliminate an organization's need to meet legal and regulatory requirements such as PCI or HIPAA. Organizations will need timely assistance from cloud computing providers to fulfill investigation/audit requirements.

Cloud computing in government:

Since the theme of cloud computing in government began to generate lots of interest and activity, discussions have revolved around whether government should rely on and even run its own "private" cloud services or whether it should leverage so-called "public cloud" services. As pointed out in **"Cloud Computing for Government Is Cloudy,"** a number of risks are associated with the use of infrastructure that is not at arm's-length control: Risks include the fact that data could be located in jurisdictions that make it vulnerable to privacy violations, possible constraints to meeting requests for e-discovery, and inadequate service levels in areas such as availability and reliability.

On the other hand, it is important for government agencies to explore public cloud computing services too, in order to achieving savings and economies of scale on less mission-critical workloads.

Below are some aspects peculiar to government.

- The first one is how agencies can collectively access cloud computing services. Over the past several years, there have been many attempts to establish consolidated and shared-service initiatives across different agencies (see "How Governments Are Addressing the IT Consolidation Conundrum"). Many of these initiatives are running or in the making, and it is very important for government organizations to position cloud computing services against such initiatives.

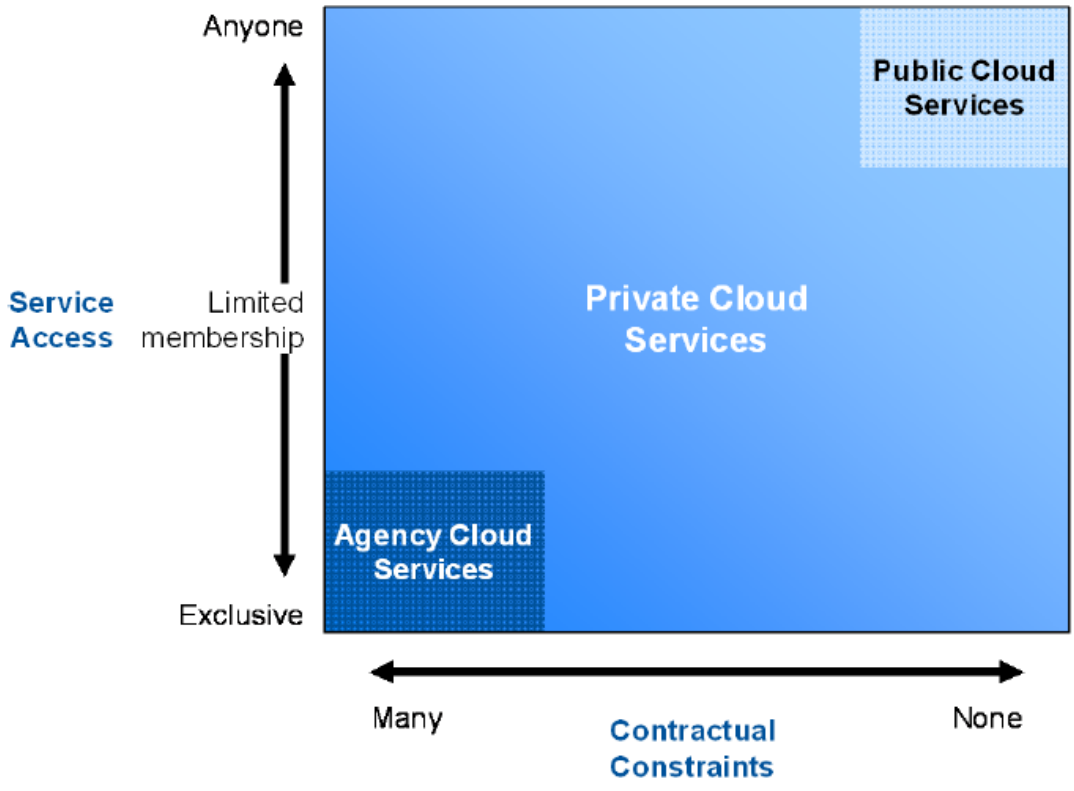
- Second, it is important to make a distinction between ownership and control. *Ownership* concerns the provider of cloud services that are used by government agencies. The owner can be either a single government organization, or a cluster of government organizations sharing resources, or a third party.

Regardless of ownership, government organizations need to exercise different levels of control on how those services are delivered. Some of this may be granted by the programmatic interface of those services, but some areas like data location, security, availability and e-discovery (see "Cloud Computing for Government Is Cloudy"), where control is needed for regulatory compliance purposes, may require peculiar contractual constraints.

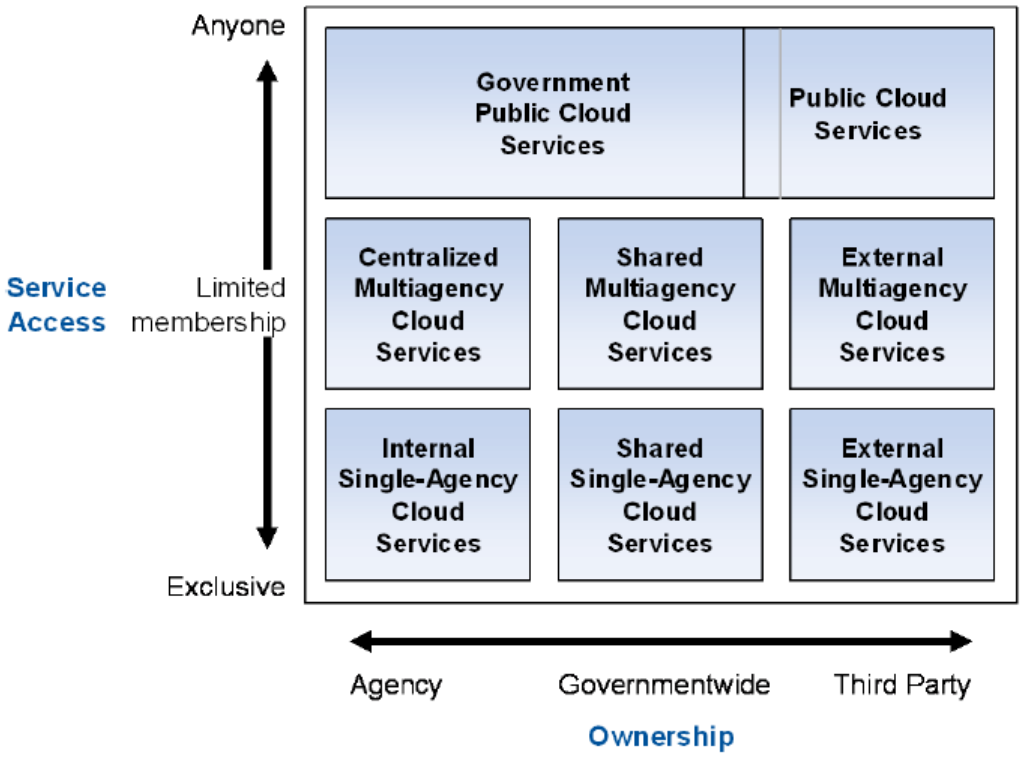
The figure illustrates the continuum from private to public cloud services from the perspective of: (1) who accesses the service (a single agency, a limited set of agencies and other organizations, or anyone); and (2) the weight and influence of contractual constraints (in areas like data location, security, availability and so forth) that are not supported through the cloud service programmatic interface, but need to be cast in the contract between clients and providers (be they government or third parties).

Therefore, while conceptually there is a continuum between private cloud computing services and public cloud ones, government IT leaders need a clearer segmentation of where cloud computing services can be used, how the control of resources can be exercised, and how they should be sourced in relation to existing or emerging consolidation and shared-service initiatives.

The Spectrum of Cloud Services in Government:



Cloud Computing in Government — Use and Ownership:



Road Ahead

Gujarat is known for its strengths in innovation in IT services & associated models, and cloud computing is an emerging opportunity in this space. It is understood that IT Giants are taking steps towards making cloud-based services available to their customers. Hence, to realize the full potential of cloud computing, a lot of challenges are required to be tackled primarily related to privacy, security, standards, interoperability, latency, performance and reliability concerns besides supporting R&D and creating specific test beds in public-private partnership with clear deliverable & collaboration with international initiative, and also further enhancing scientific & technological knowledge on all related foundation elements of cloud computing.

e Governance News

Gujarat wins prestigious UN Public Service Award

The Government of Gujarat has secured United Nations Public Service Award 2010 in 'Improving transparency, accountability and responsiveness in the public service' Asia Pacific category, for its **State-Wide Attention on Grievances by Application of Technology (SWAGAT)** at Chief Minister's office.

The ministers of the state government Shri Jaynarayan Vyas & Saurabh Patel outlined the brief of award & said that Gujarat's award was handed out at the 2010 UN Public Service Awards Ceremony on 23rd June, in Barcelona, Spain, coinciding with the United Nations Public Service Day. The award received by the Shri A. K. Sharma, secretary to the Chief Minister.

The UN Public Service Award recognizes the creative achievements and contributions of public service institutions that lead to a more effective and responsive public service administration in countries worldwide. Through an annual competition, the UN Public Service Awards promote the role, professionalism, and visibility of public service.

The Chief Minister of Gujarat said: "People's voice is the key driver of a democracy, and listening to that voice is the key test of Good Governance". The award comes as a result of the hard work of the administration at all levels: State, District and Taluka. Winning the 2010 UNPSA has rewarded the dedication of all the administration who have invested in the project.

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