



*cutting through complexity*™

# The Cloud

## Changing the Business Ecosystem

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# Foreword

Technology has always played the role of a disruptive force that somehow connects discontinuities and changes business models, ecosystems, or even the world order. Paradoxically, it has sometimes created a level playing field, and at times 'unfair' advantages for some countries or enterprises. This is evident all through out history right from the stone-age, to the industrial revolution, to the silicon era, to the internet/dot com age and to the current age of convergence/mobility. Technology could transform the world into the virtual space, enabling endless cycle of innovation.

Advanced economies like US, UK, Germany, and Japan have been at the forefront of combining innovation and technology. This has enabled them to become superpowers that have the economical, defensive and financial muscle. Same has been the case with enterprises like IBM, Microsoft, Google, Apple, Siemens, Sony, CISCO, Nokia, etc. At the same time, it has created a level playing field with the rise of telecommunications and the internet. This leveling has helped in creating emerging leaders like India and China who are leveraging favorable demographics with technology.

Technology is often a savior during the downward economic cycles as it enables the creation of more efficient business models and ecosystems. Ironically, sometimes it also leads to economic downturns as the euphoria over technology powered business models cause unrealistic expectations in the capital markets, creating bubbles which inevitably burst for e.g. the dot com burst.

The Cloud is another such phenomenon that has stirred up interests and investments in many parts of the world. Research has indicated that the worldwide Cloud services revenue is forecast to reach USD 68.3 billion in 2010, a 16.6 percent increase over the previous year.<sup>1</sup> There are many challenges and questions ranging from data privacy and security to whether the time has come for the Cloud.

The future belongs to those who will truly understand the present scenario, manage risks, and innovate with a vision to create a new order.

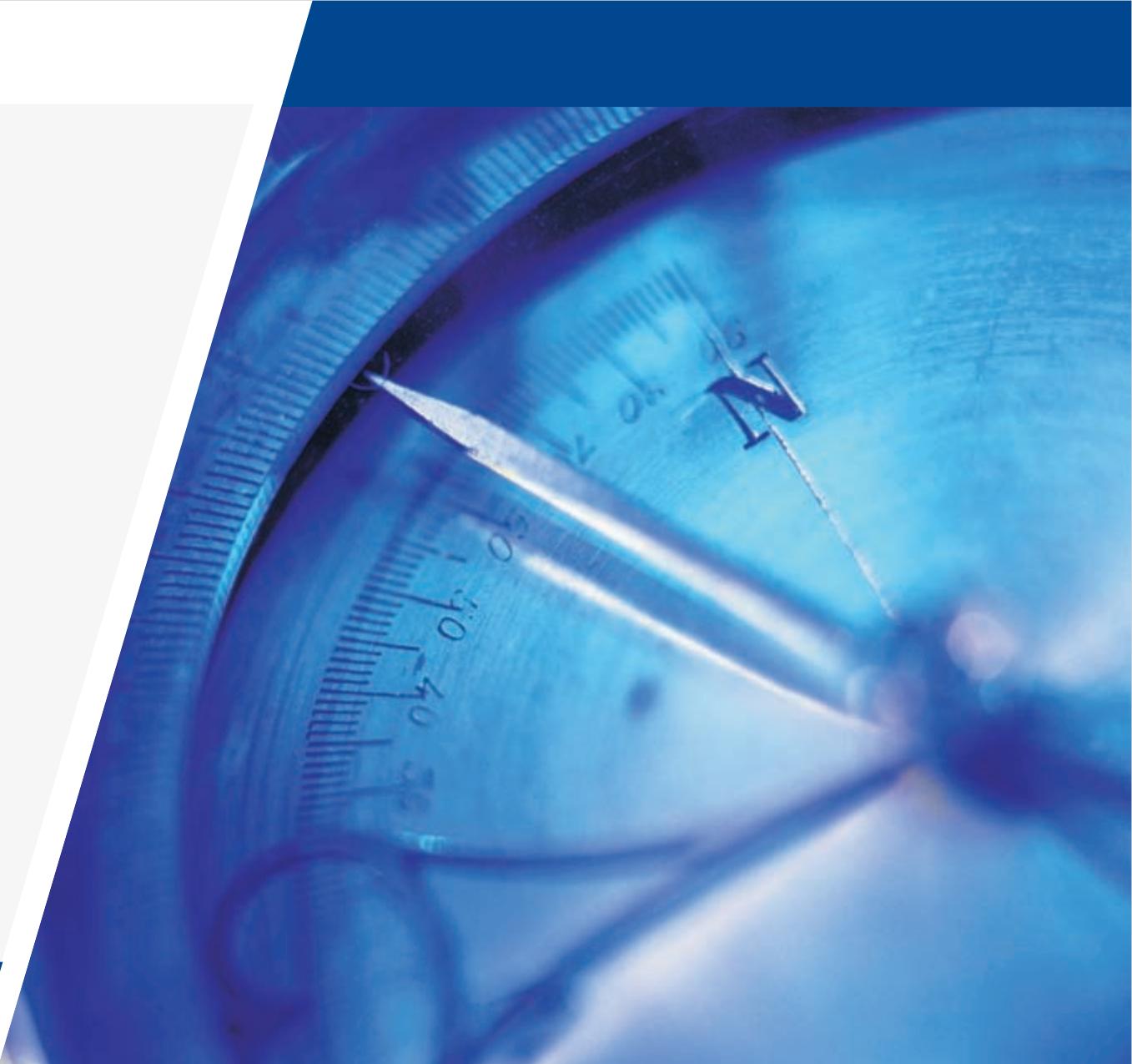


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1. Gartner, 'Gartner Says Worldwide Cloud Services Market to Surpass \$68 Billion in 2010'



# Setting the Context



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Each decade, since the 1970s, has seen the evolution of IT into a whole new 'avatar'. Mainframes (1970s), Rise of the Personal Computer (1980s), Client Server Architecture (1990s), are a few well known avatars. Meanwhile, what helped the adoption of these advances in IT was that each new avatar was preceded by a recessionary phase. Recessions brought about a greater need for businesses to improve efficiency levels and increase profitability. As a result, businesses and individual users rapidly adopted the modern avatars of IT with the objective of realizing their benefits.

The double dip recession, in the early part of the 1980s, was almost immediately followed by the Rise of the Personal Computer (PC). The number of PCs installed grew from less than 1 million in 1980 to over 100 million by the end of the decade<sup>1</sup>.

Similarly, the recession due to debt, rising inflation, etc. in the first half of the 1990s was followed by the growth of the Client Server Architecture and the internet. There were only a few thousand users of the internet at the start of the decade which ended with over 300 million users<sup>1</sup>.

Recently the world has gone through an economic downturn and there is an even stronger need for organizations to improve efficiencies by using collaborative solutions and real time information exchange. The Cloud could therefore be the next big thing with it gaining prominence during the recent credit crisis. The promise of the Cloud possibly lies in the flexibility, scalability and cost benefits made available through the 'as-a-service' paradigm.

### **Impact of IT evolution**

The increasing use of IT brought with it overheads in the implementation and maintenance of computing systems. The amount of time and finances invested in managing IT, which has become complex over a period, has increased exponentially. This also resulted in the growth of IT companies and the outsourcing of IT management.

The last century saw IT becoming a key business enabler. The dot com bust followed by the recession and financial crisis, saw an increasing demand from IT to do more with less. Technology and connectivity meanwhile evolved quickly with the introduction and adoption of technologies like XML, SOA, Web 2.0 and high speed internet connectivity.

However, the impact of the computing evolution cannot be seen from the narrow lens of IT impacts only. IT has been one of the key disruptive technologies for the last many decades. It has changed how individuals and businesses function.

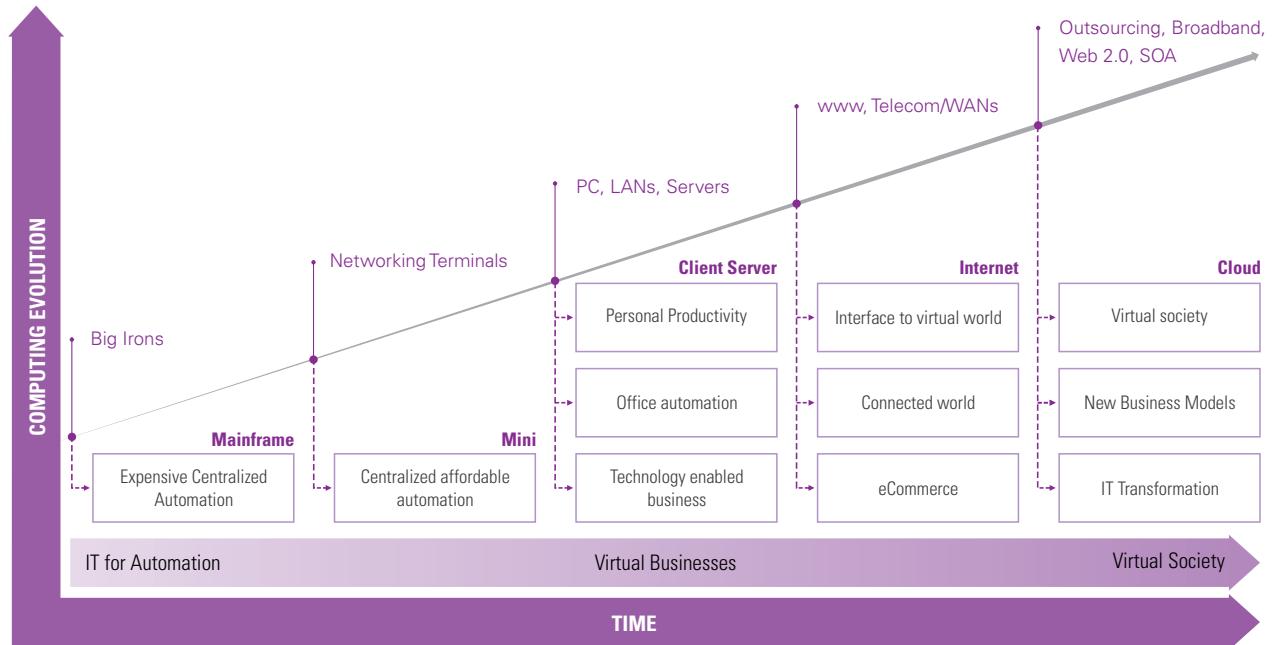
The constant evolution of computing has helped businesses to automate and innovate providing them a competitive advantage in the global marketplace. A study of business history would reveal that the rapid rise of US-based organizations was due to their ability to quickly leverage IT for their business needs. On the other hand, organizations from other parts of the world were relatively slow in leveraging IT. However, over time IT has become a hygiene factor and large scale adoption has led to leveling of the playing field.

Nevertheless, with the coming of the Cloud, organizations are once again at the crossroad of technology. Early adoption of the Cloud can provide organizations with an opportunity to transform their business models and gain a competitive edge. While cost reduction is one of the benefits, several other benefits accrue to organizations. Organizations would be able to concentrate on their core competencies while leaving the task of running IT infrastructure to the Cloud service providers. Further, through the adoption of the Cloud, organizations are expected to become more nimble. The Cloud would help them quickly provision resources for business opportunities, which could otherwise be lost. The Cloud also enables organizations to build virtual and "open" business processes, enabling its various stakeholders including customers, business partners, suppliers, etc. to connect and do business more seamlessly.

1. IDC, 'Whitepaper on 40 years of IT'

## Socio-economic impact of IT evolution

Figure 01



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

While the impact of computing evolution on businesses is well chronicled, its impact on people and society has received much lesser coverage. In the early stages of the computing evolution, IT was mainly restricted to business use. However, the coming of PCs helped individuals automate and enhance their own lifestyle. From being able to store personal information, to automating their finances, IT has emerged as a 'personal' priority for individuals. The convergence of business and Internet, IT has, in fact, changed the lifestyle of people. Today it is impossible to imagine a life without a search engine, which delivers information at a click of a button!

Moreover, through social networking, virtual communities have become an indispensable part of our lives. Facebook, Twitter, LinkedIn and other virtual platforms have enabled millions to connect, share and leverage technology to enhance their life experiences. These platforms are different shapes of the Cloud which enables rapid development and scalability.

The coming together of technology, business needs and economic factors was the 'perfect storm' which led to the birth of the Cloud.

### Anatomy of the Cloud

In order to understand the Cloud, it is important to understand what can exactly be called a Cloud. While there are numerous definitions of the Cloud, it can be explained very simply as follows:

**The Cloud** = **Internet-based data access & exchange** + **Internet-based access to low cost computing and applications**

In order for any offering to be termed as a Cloud it should have the following characteristics:

<b>Characteristics</b>	=	<b>On-Demand Self-Service</b>	<b>Internet Accessibility</b>	<b>Pooled Resources</b>	<b>Elastic Capacity</b>	<b>Usage-Based Billing</b>
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Further, the Cloud is defined in terms of three Service models and four deployment models as depicted below:

Cloud Service Models			Cloud Deployment Models	
Software as a Service	Platform as a Service	Infrastructure as a Service	Private	Community
Business operations over a network	Deploy customer-created applications to a Cloud	Rent processing, storage, network, other computing resources	Operated for a single organization	Shared by several organizations, supporting a specific community
"SaaS"	"PaaS"	"IaaS"	Public	Hybrid
			Available to the general public or large industry group, owned by an organization selling Cloud services	Two or more Clouds that remain unique but are bound by technology that enables data and application portability

## Drivers and challenges of the Cloud

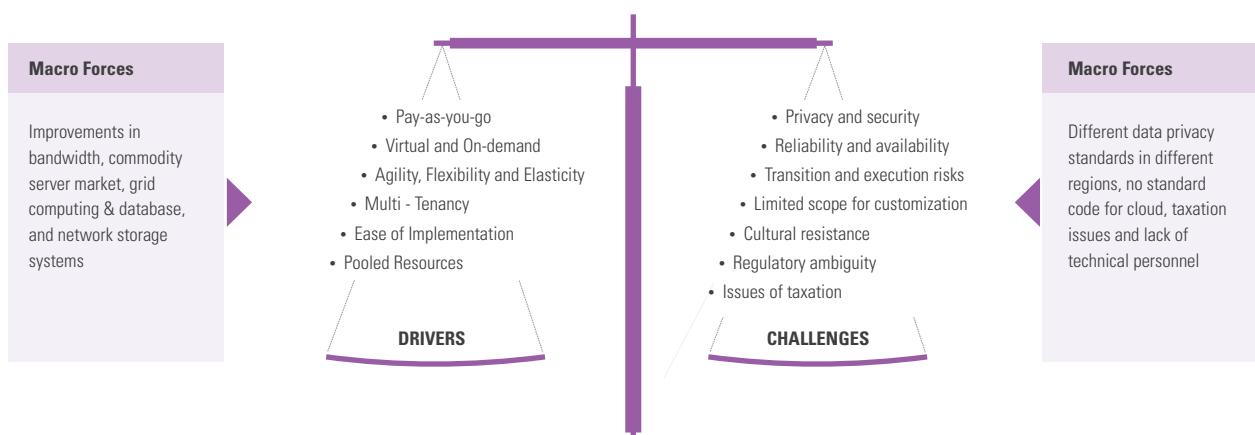
There are several drivers and challenges of Cloud adoption today.

The Cloud makes a compelling business case on both technical and commercial aspects. It seeks to replace the CAPEX<sup>2</sup> component of the current IT infrastructure with a 'Pay-as-you-go' or OPEX<sup>3</sup> model. This model needs to be carefully studied by organizations to ascertain its impact on the cash flow and profitability. Further, tax-related issues also need to be taken into account in order to arrive at the real implications of the adoption of the Cloud from a bottom line perspective. At the same time, organizations must take into account non-commercial benefits such as scalability and ease of implementation. These benefits of the Cloud help organizations quickly source computing resources On-Demand.

While there is a strong case for the adoption of the Cloud, there are several challenges that need to be overcome. Security continues to be the key challenge for Cloud adoption. Organizations are yet to get comfortable with the idea that their data would be secure and would not be misused once ported onto the Cloud. Other major challenges are availability, regulatory and tax-related issues.

## Drivers and challenges of the Cloud

Figure 02



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

2. Refer to glossary  
3. Refer to glossary

## Changing IT ecosystem

The Cloud is the emergence of a new way of delivering computing services and as such it will impact nearly all facets of the IT ecosystem. Most importantly, IT solutions and services vendors will now need to adapt their infrastructure, people and processes.

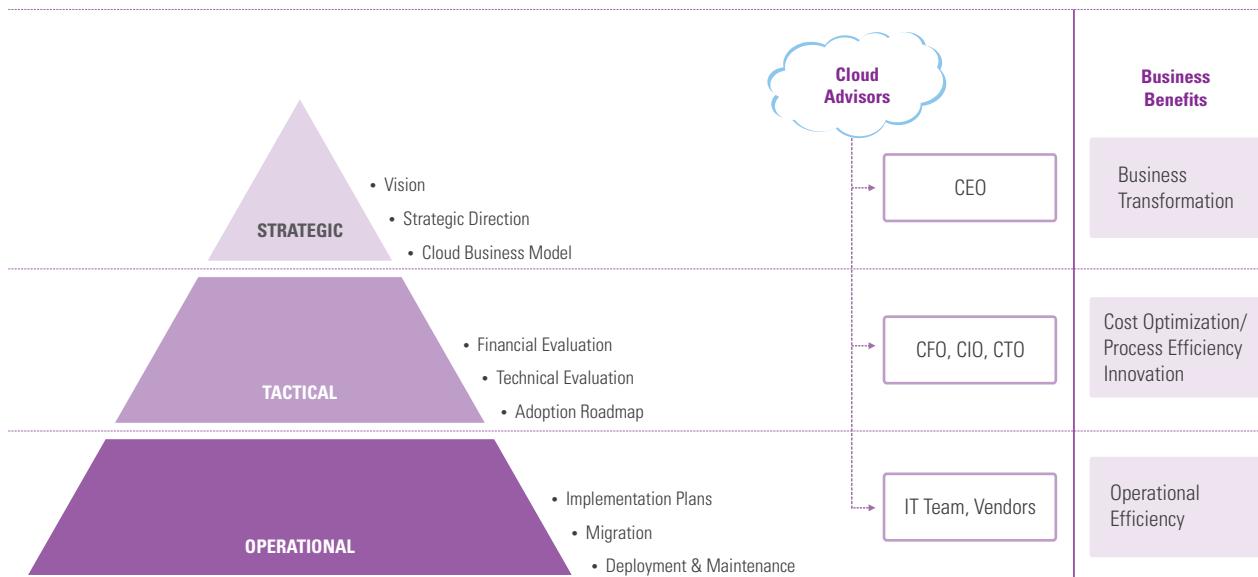
### People

The Chief Information Officers (CIOs) role has undergone a few changes since the beginning of the 21st century. With the advent of the Cloud, CIOs would now be expected to play the part of a Strategic Executive who would work towards bringing about business transformation through innovation in the way modern technology is adopted by the organization. The CIO would also be expected to aptly guide the leadership on the development and the execution of a Cloud strategy. The in-house IT team would need to focus more on using the Cloud to quickly meet the business needs rather than configuration and implementation of application on in-house hardware.

A deeper understanding of the Cloud paradigm would indicate that business leaders have a major role in the adoption of the Cloud.

## Roles and responsibilities of the leadership

Figure 03



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

This is primarily because implementing the Cloud is largely a strategic business decision rather than a purely technology decision. Business leaders have a much larger role to play in the adoption of Cloud services as it is a decision that would be driven by business needs and financial considerations.

### Processes

The ability to quickly provision computing resources would enable organizations to leverage the Cloud to quickly meet business needs. Businesses could easily scale up and down, responding to market needs in a nimble manner. This could lead to the development of new business models and enable organizations to serve their clients more effectively. SaaS offerings would also have significant impact on business processes and would lead to large scale standardization.

### Infrastructure

On-Premise / Co-located data centers could be substituted through the use of IaaS service model of the Cloud. Similarly, developing and hosting applications through the PaaS service model would be a

cost-effective and time saving approach to application development. Delivery and the use of software over the internet based on the Cloud service model of SaaS makes it easier for users to source and manage software in a dynamic environment. This would necessitate use of a high capacity and reliable network connectivity to access the Cloud.

## Impact of the Cloud on the Industry

While the Cloud could benefit all sectors in one way or the other, the impact will be fairly emphatic in certain sectors. We believe that the Cloud would be most advantageous to the Government, Healthcare, and Education sectors, as the stakeholders include large sections of society.

### Government

Governments can leverage the Cloud to bridge the communication divide, especially with those citizens that reside in remote parts of the country. The Cloud could also be used to increase interoperability between various government agencies, reduce redundancy, track / monitor the effectiveness of government schemes. Computing resources shared between Central and State governments would result in reducing costs by leveraging existing infrastructure. Transparency in Government can be achieved at a faster pace through the adoption of Cloud. The Cloud has the potential of transforming this sector, to benefit not only the Government itself, but also millions of people.

### Healthcare

The Cloud is a paradigm shift in the use of Healthcare Information Technology (HIT), which enables stakeholders to focus more on their core competencies. In the case of the Healthcare industry it would provide for the seamless management and access to Electronic Health Records (EHRs) of patients. This would facilitate the provisioning of healthcare products and services to patients located in remote areas and those that have limited access to quality medical services.

The use of the Cloud could possibly result in a change in business models, automation of processes, streamlining of workflows, and a consolidation of IT assets for Healthcare service providers. The creation of an integrated Healthcare ecosystem would help the providers of healthcare services make available the best of services to patients.

### Education

Though the Education sector has seen significant transformation in the last decade, the challenges of high cost, limited reach and quality are still matters of grave concern. The Cloud might just prove to be the catalyst that will enable the sector overcome these barriers.

The Education sector which has already embraced the use of the Cloud for email services could now consider moving critical applications such as Virtual Learning Environment (VLE), Learning Management Systems (LMS) and Student Information System (SIS) into the Cloud. The Cloud promises to make the Education system more collaborative and innovative with unique resources readily available to all students. This could change the way in which education is delivered and financed.

### Small and Medium Enterprises (SMEs)

SMEs have been largely unable to take advantage of IT systems and solutions due to the high up front costs of sourcing and deploying the same. Consequently, they are known to face issues in the management of their supply chains, financials, inventories, customer relationships, and human resources.

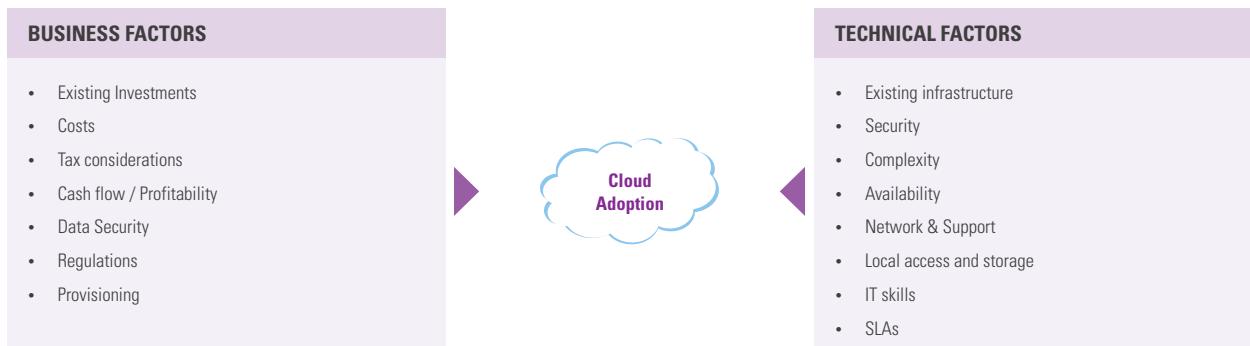
The Cloud reduces the cost burden of using IT for SMEs, especially because Cloud services provided access to a usage based pricing model. Other benefits like scalability, flexibility, and On-Demand service are highly attractive proposition to this user group. Thus the adoption of the Cloud, amongst the SMEs could be the highest in comparison to the rest of the business community.

## Embracing the Cloud

Before venturing to embrace the Cloud, organizations would need to evaluate a number of concerns. These concerns can be grouped into two parts namely Business Factors and Technical Factors.

Migration concerns of the Cloud

Figure 04



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

To attain the maximum benefit from migration to the Cloud it is essential that organizations develop a Cloud Strategy, which takes into consideration commercial and technical concerns. This strategy should not only define how a move to the Cloud would be made but also identify various factors, which include the type / combination of Cloud service and deployment models to be used, how services of the Cloud would be governed, the process of identifying the requirement for, and deployment of new Cloud services, the level of interoperability between Cloud services, etc.

In a gist, to get the maximum out of the Cloud, it is important that organizations should carefully plan their move taking into consideration commercial and technical concerns.

## Conclusion

The Cloud is a game changing phase of IT that is not only impacting the way computing services are and will be delivered but also the way in which users will use IT. The Cloud promises several benefits in commercial and technical terms but the challenges too need to be considered when planning for Cloud adoption. Businesses will also need to redefine their business models to better reflect changing trends in the use of IT i.e. Cloud services. As such, the roles of the leadership will also change to better reflect the realities of the Cloud.

Amongst industry sectors, the Government, Healthcare, and Education sectors would benefit the most as the Cloud provides them with the socio-economic reach that they lacked for decades. Similarly, the Cloud promises to deliver affordable, reliable, and flexible computing solutions to SMEs, enabling them to compete more effectively with larger organizations.

A move to the Cloud, however, requires a well planned strategy as there are many business and technical constraints that need to be mitigated. Regulations are needed to clear doubts with regards to transfer of data across borders and the ownership / security of data stored on the Cloud.

On the whole, the IT solutions and services industry may significantly change in order to accommodate this new service offering. Businesses have and would continue to adopt the Cloud in order to stay ahead of the curve. The Cloud is not just a passing phenomenon but a reality that has just begun to realize its potential.





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# Relevance of the **Cloud**

## Changing role of IT

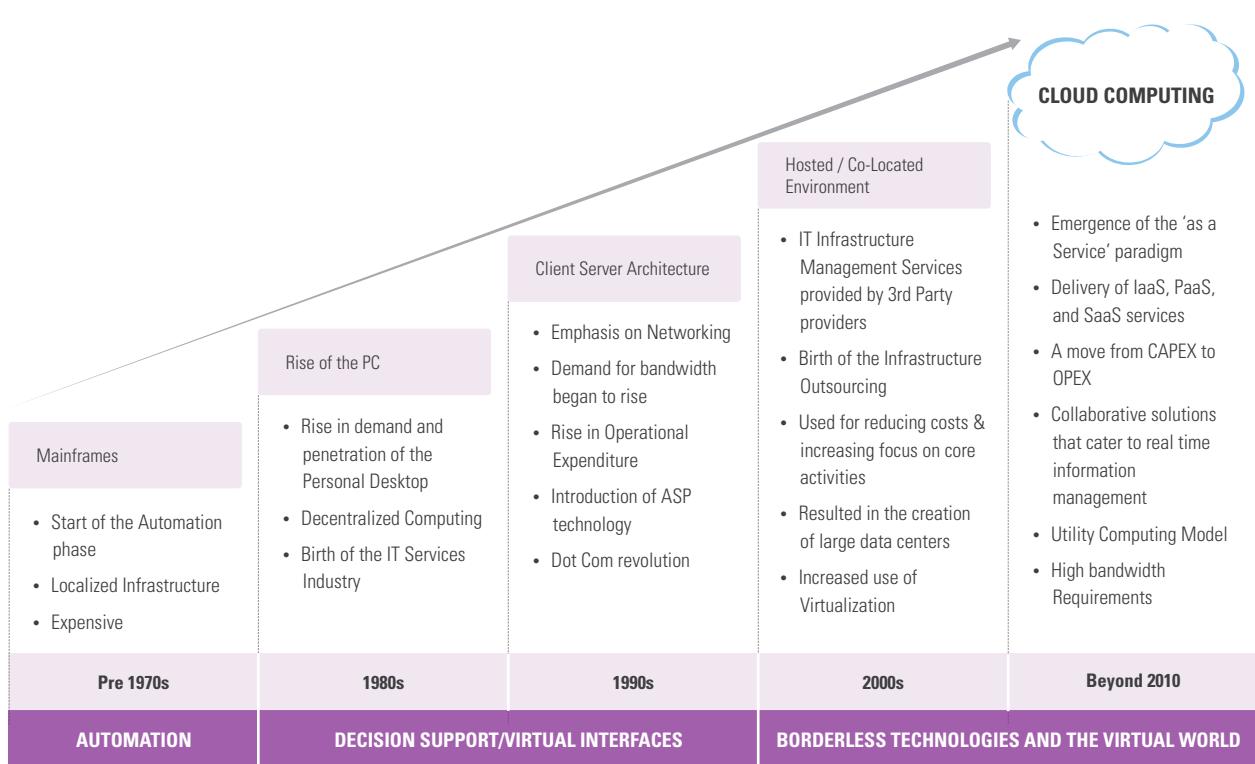
Cloud Computing, popularly known as 'the Cloud', promises to change the face of Information Technology (IT) as we know it today. IT is recognized not only as a business enabler, but also as a strategic tool that will redefine business objectives. However, of late the proliferation of IT in most large organizations has leveled the playing field. The emergence of the Cloud could lead to a new round of innovation in business processes. Existing business models may need to change to be able to leverage on the strengths of the Cloud. Further, totally new disruptive business models will emerge based on the Cloud.

Technological advancements such as the introduction of high-speed broadband, 3G<sup>1</sup> and 4G<sup>2</sup> technology (long term evolution), high-efficiency blade servers<sup>3</sup>, network optimization solutions, etc. could enable the IT industry to provide dynamic and value-driven services and solutions. Businesses now demand more flexibility, scalability, cost-efficiency and ease of use from the IT solutions and services used by them.

A dynamic IT environment, that caters to real time information requirements, could help businesses not only meet their existing business objectives but also set up new ones.

**Evolution of computing**

**Figure 01**



**Source:** KPMG's The Cloud: Changing the Business Ecosystem, 2011

## IT in business

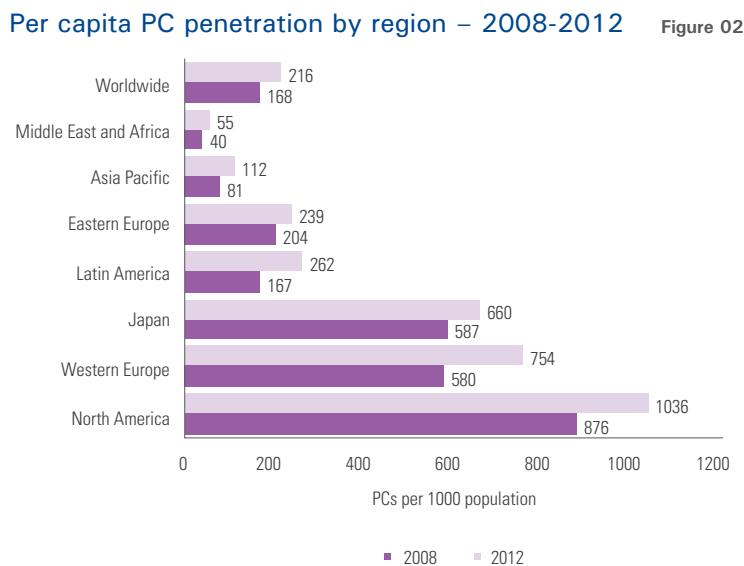
Business environments are becoming increasingly complex and competitive. At the same time, the expectations of customers are also increasing. With companies now looking for new ways to enhance the quality of their products and services through IT, the traditional model seems to be inadequate. Sourcing and deploying IT systems and solutions, using the traditional model, may not result in the optimal utilization of resources while requiring large investments to continue functioning. Businesses not only have to setup an in-house (On-Premise / Hosted) computing environment but they also have to build / source IT teams to manage the same – thus adding on to costs.

1. Refer to glossary
2. Refer to glossary
3. Refer to glossary

Some of the key challenges that are associated with the traditional model of sourcing and providing IT services are as follows:

- **Limited IT budget:**  
Initially, the IT budgets of organizations were limited as IT was looked upon as a support function. The recent economic downturn has put a strain on the IT budget of most companies. Setting-up an On-Premise computing environment or upgrading existing systems requires substantial investments.
- **Scalability of systems:**  
Current IT frameworks and design principles are not very flexible and could result in a design overhaul of existing solutions, to accommodate drastic changes to user requirements. E.g. system administrators manage peak demand for server access by investing in additional hardware and software resources which are under utilized during non-peak loads.
- **Longer gestation period for setting up the IT infrastructure:**  
The traditional process of designing, developing, and deployment of solutions is time consuming and iterative. Consequently, this could negatively affect the execution of various business processes especially when there is a need for the rapid development and deployment of applications.
- **Infrastructure management:**  
Management of the entire IT function requires investments in the form of time, professional expertise, and financial investments. Moreover, managing IT infrastructure might not be a core competence of a company. This is a constant challenge in most organizations.
- **Need for enterprise mobility:**  
Owing to convergence in global markets and the need to stay connected round the clock, business executives are now demanding a well connected environment that caters to real-time information interchange. The traditional environment needs a significant overhaul to be able to meet the expectations of a virtualized / connected environment.

## Factors fostering the growth of the Cloud



**Source:** Deutsche Bank and Gartner, 'Report: Changing PC sector, market share, emerging markets, forecast considerations', September 2009

Some of the key factors that are driving the acceptance of Cloud services are as follows:

- **Rising computer penetration:**  
The past decade has seen the increasing acceptance of the internet as a medium of communication for businesses. Computers and internet connectivity are the prerequisites for the adoption of the Cloud. Growing penetration of computers is resulting in an increase in the demand for affordable computing solutions.
- **Improvement in bandwidth availability:**  
The past decade has seen the rapid rise in the availability of internet bandwidth at increasingly lower costs. Data transfer rate over wireless networks has now reached 300 Megabytes per second (Mbps) while it stands at a speed of 1 Gigabyte per second (Gbps) for data transfer over wired networks. At the same time, there has also been a significant improvement in the reliability of the connection.

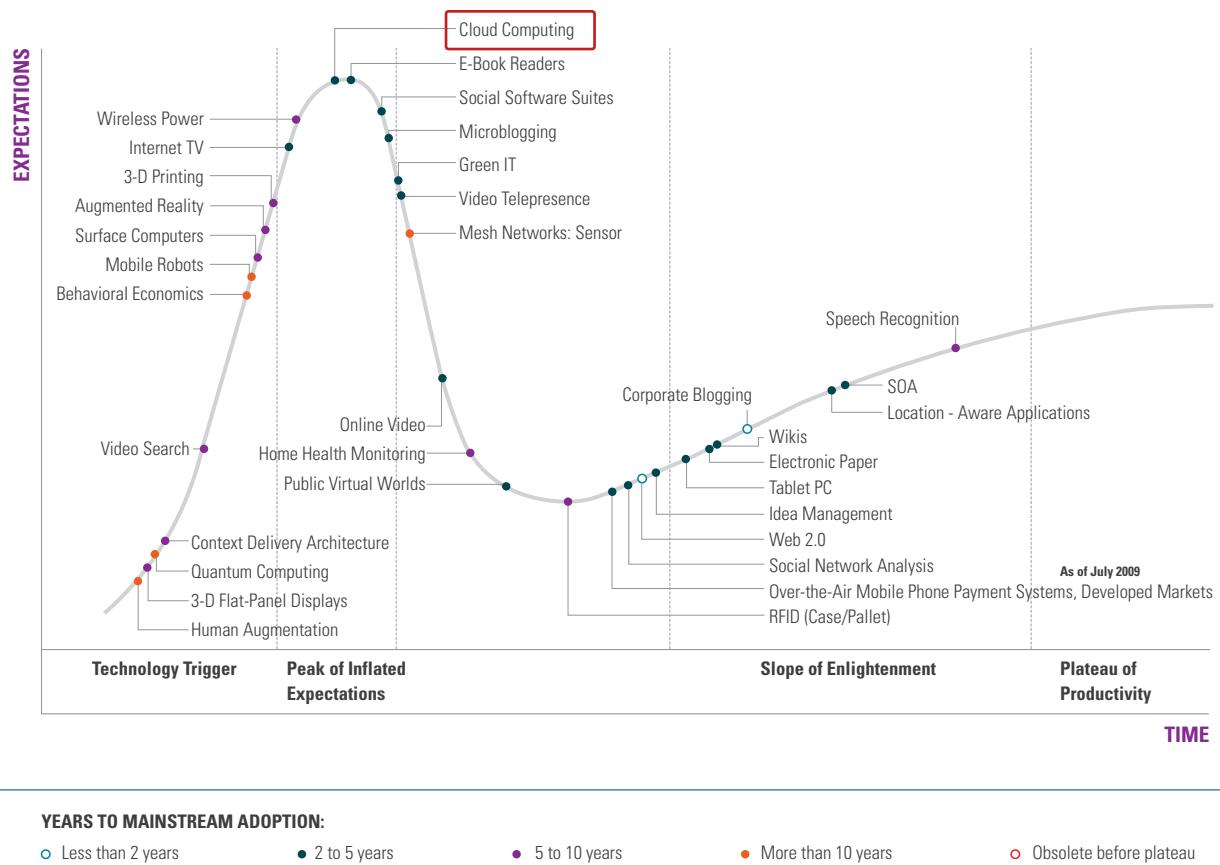
- **Innovations in commodity server market:**  
There has been a significant improvement in the quality of servers that are now available, with faster and powerful processors in place. These servers have become more efficient and less expensive making them more viable for the Cloud. Moreover, innovations in interconnect technology (such as InfiniBand), have made the use of servers in clustered environments and application execution more feasible and efficient.
- **Improvements in storage technology:**  
The growing need to share data between various applications in units as big as terabytes is increasing the demand for networked storage - a shift away from direct attached storage. Capabilities of servers to run multiple applications and increased relevance of virtualization have further acted as an impetus for the growth of network storage.

## Emergence of a new era: The Cloud

The Cloud is the emergence of a new era that could possibly revolutionize the way IT is used in business. The Gartner 'Hype cycle for emerging technologies' given below is a depiction of the Cloud on the technology lifecycle.

Hype cycle for emerging technologies – 2009

Figure 03

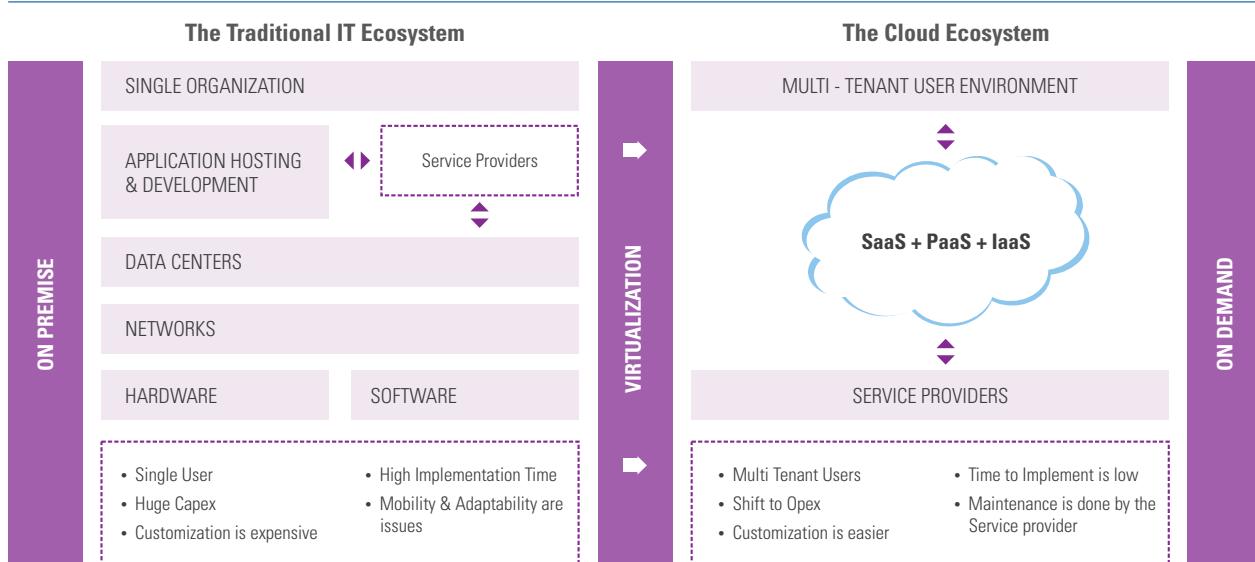


The Cloud is used to cohesively identify a series of technological innovations / advancements in the fields of IT and telecommunications. These advancements have together to complement each other thereby leading to the creation of an offering called 'the Cloud'. As this offering is rather new, businesses are trying to keep pace with the Cloud while trying to grasp the pros and cons of the same.

In simple words, the Cloud refers to the process of sharing resources (such as hardware, development platforms and/or software) over the internet. It enables On-Demand network access to a shared pool of dynamically configurable computing resources. These resources are accessed mostly on a pay-per-use or subscription basis.

## Comparing the traditional ecosystem and the Cloud

Figure 04



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

Services of the Cloud, are made available through virtualization<sup>4</sup> and provided on a usage-based pricing model. These resources can be quickly provisioned and easily managed, by the user, without any major inputs from service providers of the Cloud. Customers sign customized Service Level Agreements (SLAs)<sup>5</sup> with service providers of the Cloud to ensure availability of services based on certain guiding principles.

## Service and deployment models for the Cloud<sup>6</sup>

The Cloud definition given by the National Institute of Standards and Technology (NIST), US, is the most widely accepted one. It defines the Cloud as having three service and four deployment models which are as given below:

### Cloud service model

#### • Infrastructure as a Service (IaaS):

The provisioning of processing time, storage, networks, and other fundamental computing resources, made available by Cloud service providers for use by customers is known as Infrastructure as a Service (IaaS). These resources can be used to deploy and run arbitrary software which can include operating systems and applications. The service provider is responsible for the management of the underlying Cloud infrastructure. Examples include: Amazon EC2, Zenith's Proud, etc.

4. Refer to glossary

5. Refer to glossary

6. Definitions are based on those given by the National Institute of Standards and Technology (NIST)

- **Platform as a Service (PaaS):**

The capability provided by Cloud service providers, for customers to use to develop and host applications is known as Platform as a Service (PaaS). The customer does not manage or control the underlying infrastructure that includes network, servers, operating systems, software for application development, etc which are managed by the service provider. Examples include: SalesForce.com's Force.com, Wolf Framework's Wolf PaaS, Windows Azure, etc.

- **Software as a Service (SaaS):**

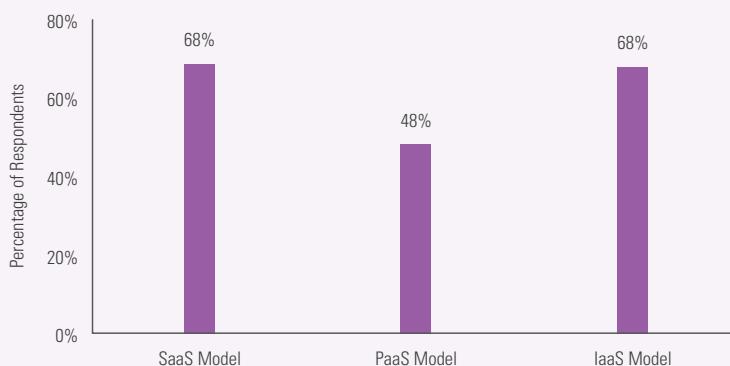
The delivery of software applications over the internet while being managed by the service provider is known as Software as a Service (SaaS). Customers are not concerned with the regular maintenance, up gradation and the management of the underlying computing infrastructure that is used to host the applications. The applications are accessible from various client devices through web browsers. Examples include: Gmail, Facebook, SalesForce.com, Zoho CRM, etc.

Planned adoption for IaaS and SaaS service models is the highest

**Survey Findings 01**

Sixty-eight percent of the initial respondents to KPMG in India's Cloud Survey\* indicated that they largely plan to adopt either the SaaS or PaaS service models. Significantly more number of SMEs, i.e. nearly 80 percent, planned to adopt SaaS as compared to larger organizations.

#### Cloud environments in which organizations plan to invest



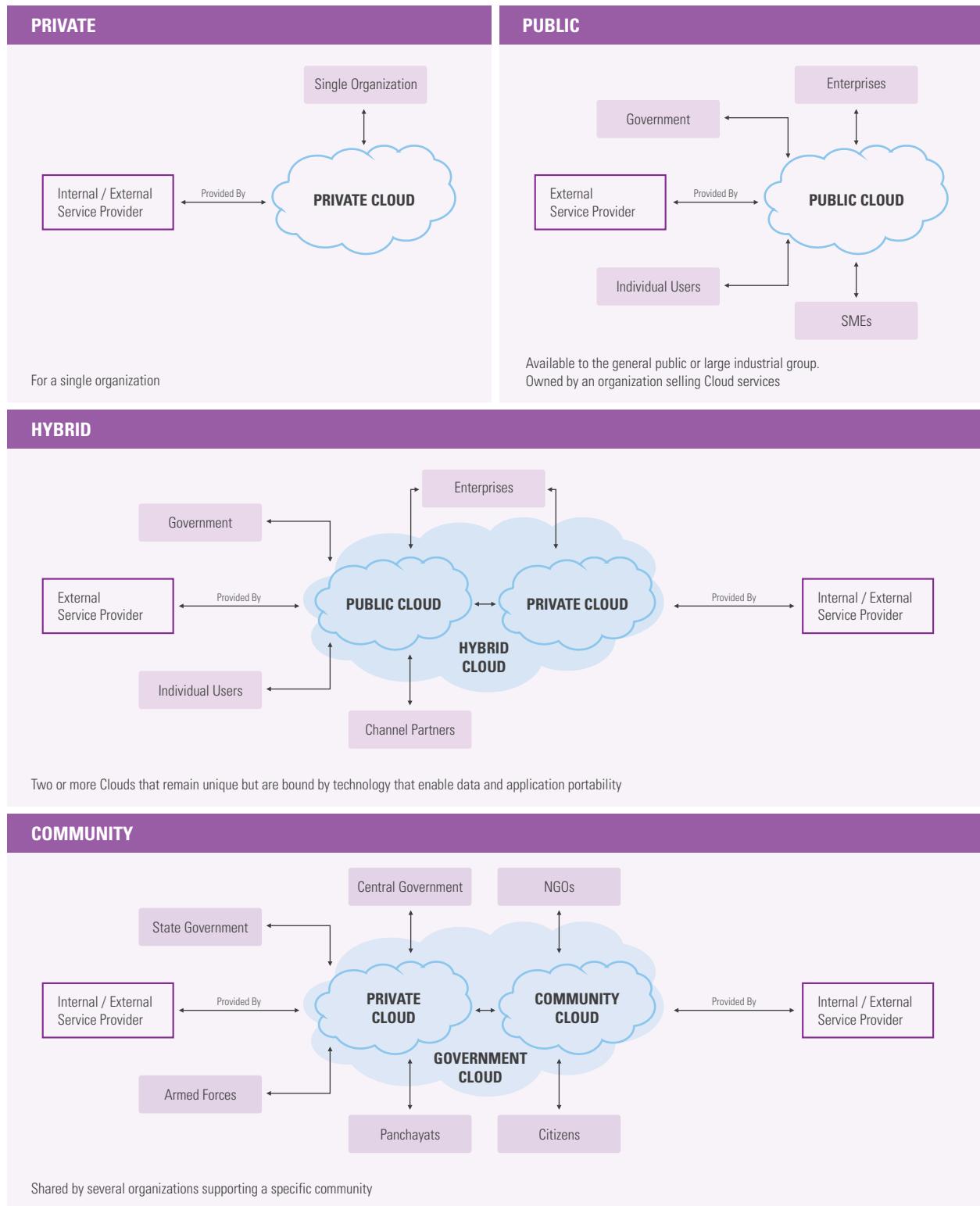
**Source:** KPMG's The Cloud: Changing the Business Ecosystem, 2011

\* KPMG in India is currently conducting a national Cloud survey. The survey aims to ascertain Cloud adoption plans of organizations as well as the challenges they foresee. The survey findings presented in this report are based on the initial responses received.

## Cloud deployment models

### The Cloud deployment models

Figure 05



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

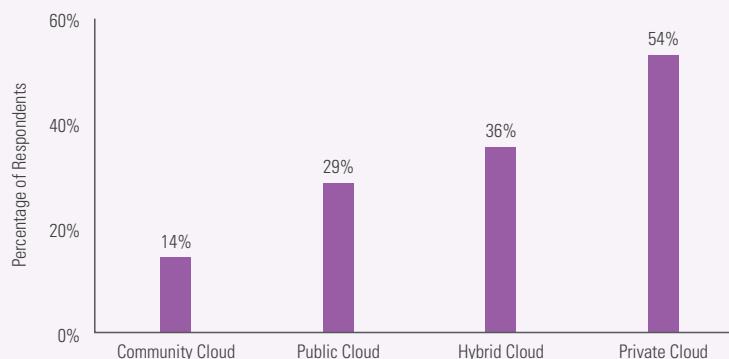
- **Public Cloud:**  
Is the Cloud in which services are available to the general public or a large group of companies – resources are shared. It is owned by a third-party selling Cloud services. An example would be the Amazon EC2 Cloud wherein the service provider, in this case Amazon, rents out storage space to businesses, governments, and individuals alike.
- **Private Cloud:**  
Is the Cloud which operates dedicatedly for a single organization. Private cloud infrastructure may be set-up On-Premise or off-premise and may be managed either internally or by third-party service providers. Private clouds offer highest level of security and control but are expensive. An example would be the NASA's Nebula Private Cloud which is an infrastructure-as-a-service implementation for scientific data and Web-based applications<sup>7</sup>.
- **Hybrid Cloud:**  
Is the Cloud which uses a combination of two or more clouds (public, private or community). The Clouds could be individually managed by multiple Cloud service providers but are bound together by proprietary technology to enable data and application portability. E.g. a company may use a public cloud for storing archived data but may use a private cloud for storing critical information like customer details and information.
- **Community Cloud:**  
Is the Cloud whose infrastructure is shared by several organizations and supports a specific community that has shared concerns. The community Cloud may be deployed On-Premise or Off-Premise and may be managed by organizations collectively or by a third-party Cloud services provider. An example would be the Community Cloud being built by the Mount Sinai Hospital in Toronto, Canada that will give 14 area hospitals shared access to a fetal ultrasound application and data storage for patient information<sup>8</sup>.

### Popularity of Cloud deployment models

**Survey Findings 02**

Over 50 percent of the respondents to the survey have indicated that they use/intend to use Private Clouds. Large organizations indicated that they plan to implement Private Clouds due to issues related to data security and performance. Smaller companies indicated reluctance towards the deployment of Private Clouds probably due to costs concerns.

### Cloud deployment models that companies use/intend to use



\* Please refer the note on KPMG in India's Cloud Survey on Page 06.

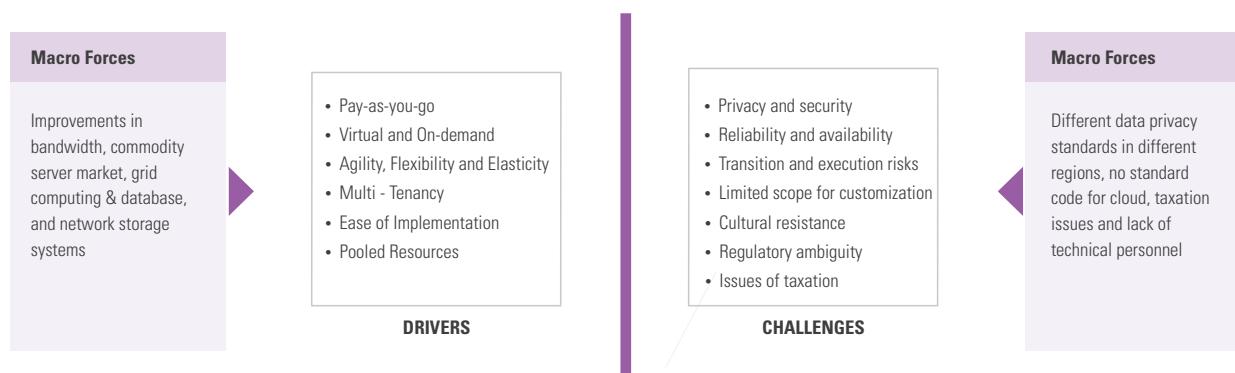
**Source:** KPMG's The Cloud: Changing the Business Ecosystem, 2011

7. ZDNet; 'NASA's Nebula: a stellar example of private clouds in government',  
8. TechTarget; 'A health care community cloud takes shape',

## Drivers and challenges of the Cloud

### Drivers and challenges of the Cloud

Figure 06



**Source:** KPMG's The Cloud: Changing the Business Ecosystem, 2011

### Drivers of the Cloud

- **Pay-as-you-go model:**  
The Cloud reduces the significant upfront capital expenditure which is needed to purchase and maintain IT infrastructure like hardware and software systems. Pricing in the Cloud is done on a usage-based or subscription-based model which converts fixed into variable costs. The advantage of being cost-efficient makes the Cloud an attractive option, especially for SMEs. According to a study, Cloud-based services generate higher cost differential for smaller companies in comparison to large enterprises. While the cost savings per employee through usage of the Cloud was nearly ten times for a company with 10,000 employees, it was as much as 109 times for a company with 10 employees<sup>9</sup>.
- **Multi-tenancy:**  
The Cloud resources run in multi-tenancy mode which means multiple users can access the infrastructure simultaneously from different organizations. Multi-tenancy also allows service providers of the Cloud to take significant cost advantages and better profitability, allowing them to make more R&D investments. The benefits are passed-on to the Cloud users making the Cloud solution a cost-effective option.

#### Case Example 01 - Cloud providing flexibility of resources

Indy 500 website ([www.indy500.com](http://www.indy500.com)) stores more than 100,000 images using Amazon S3. It uses Amazon Elastic Compute Cloud (EC2) to host and stream live motor sport races to over 3.1 million visitors. Indy 500 began using Amazon S3 as the peak usage during races could not be accommodated using internal infrastructure. Use of Amazon EC2 also resulted in savings of more than 50 percent in the firm's costs.

**Source:** Amazon

- **Elasticity of resources:**  
Services of the Cloud are available On-Demand which allows customers to upscale/downscale capacity without incurring any capital expenditures. Service providers of the Cloud are able to juggle between servers and data centers to shift resource utilization as per the demand patterns and user specific SLAs. This provides agility and flexibility to the users.

9. Merrill Lynch Analysis; 'the Cloud Wars: \$100+ billion at stake', May 2008

- **Ease of implementation:**

Using Cloud-based applications is much easier than building new applications and data centers. Moreover, the entire management of the resources provided rests with the Cloud service providers themselves. The user interfaces of Cloud solutions are also very user friendly than the interfaces of traditional software.

#### **Case Example 02 - Cloud helps reduce Time-to-Market**

According a study conducted on 10 companies of different scales located across the US, Europe and Asia-Pacific; custom applications developed and deployed on Salesforce.com (force.com) resulted in following business benefits:

- Custom applications were developed and deployed in 76 percent lesser time and required 76-85 percent lesser developer hours.
- Companies reduced total cost of operations by 54 percent.
- Annual downtime reduced by 97 percent and time taken in dealing with service desk reduced by 60 percent.

**Source:** IDC Analysis

- **On-Demand self-service**

The most important feature of the Cloud is that users can use computing capabilities as and when they require the same without requiring any human intervention from the service provider of the Cloud. The user would not have to worry about commissioning / decommissioning computing infrastructure as per utilization / requirements.

- **Reduces carbon footprint:**

Technological advancements and financial limitations are indirectly contributing to a decrease in number of servers and energy consumption. According to a study conducted by Microsoft, Accenture and WSP Environment & Energy, the Cloud solutions of Microsoft can reduce carbon emissions between 30-90 percent depending on the size of organization<sup>10</sup>. Moreover, stringent regulations such as RoHS (Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations) and WEEE (Waste Electrical and Electronic Equipment Directive) in Europe are also forcing suppliers in other parts of the world to re-engineer their processes and move to Greener IT.

### **Challenges in the implementation of the Cloud**

Being virtual in concept, the Cloud environment generates several questions in the minds of users with respect to confidentiality, integrity and availability. The key challenges for the adoption of the Cloud are as given below:

- **Assurance of privacy and security:**

The Cloud users are wary of the security and privacy of their data. The Multi-Tenant environment of the Cloud is causing concerns amongst enterprises. As the same underlying hardware may be used by other companies and competitors, it may lead to a breach of privacy. Moreover, any data leakage or virus attack would have a cascading effect on multiple organizations.

- **Reliability and availability:**

Instances of outages at the facilities of the Cloud service providers have raised concerns over the reliability of the Cloud solutions. Enterprises are recognizing that they would have to deal with some level of failures while using commodity-based solutions. The Cloud service providers may guarantee 99.9 percent uptime (approximately one hour of downtime in a year), however, companies could still worry about the loss of control when an outage occurs. Also, the Cloud providers can not give an assurance on the uptime of their external internet connection, which could shut all access to the Cloud.

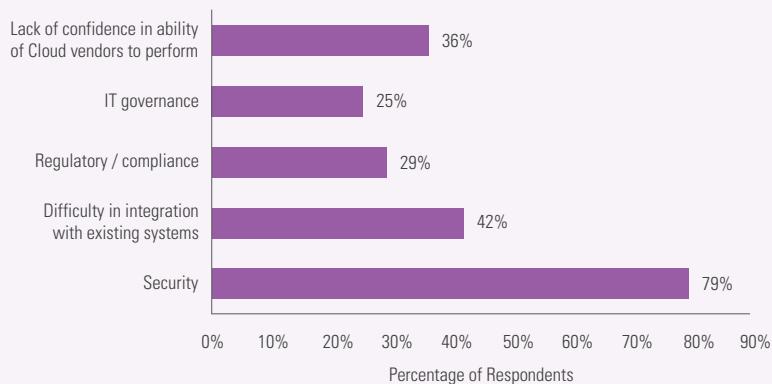
10. Microsoft, Accenture and WSP Environment & Energy, 'Cloud Computing and Sustainability: The Environmental Benefits of Moving to the Cloud', 2010

## Data security is a key concern

**Survey Findings 03**

There are a number of concerns surrounding the adoption of the Cloud especially because it is a relatively new concept. Assuring customers of data security would be one of the biggest challenges for Cloud vendors to overcome. Nearly 80 percent of respondents to KPMG's Cloud Survey highlighted security as a key inhibitor in the adoption of the Cloud. The other concerns were related to difficulty in integration and lack of confidence in vendor support.

### Key barriers to Cloud adoption



Figures in the chart do not add up to 100 percent as multiple responses have been chosen by each respondent

\*Please refer the note on KPMG in India's Cloud Survey on Page 06.

**Source:** KPMG's The Cloud: Changing the Business Ecosystem, 2011

- **Transition and execution risk:**

Certain mission-critical applications may not be suitable to be used in the Cloud environments. It is important to undertake a thorough risk assessment before migrating any application on to the Cloud. The criticality of the application, availability of the Cloud services, loss due to outages, security/privacy breach, etc. need to be assessed.

- **Cultural resistance:**

Cloud users may face organizational inertia as shifting to a Cloud environment may change the role of IT departments in the organization. Organizations may not be prepared for this transition with many of them deciding to wait and watch.

### Case Example 03 - Different compliance standards in various regions

There are several compliance standards that regulate data privacy and information security and hence may influence the use of the Cloud. Some of these are:

- SOX, 404 in the US which stipulates for how long and in what manner can data be kept and ensuring security of financial information.
- Regulations related to email in countries such as Germany and the UK.
- Regulations such as Markets in Financial Instruments Directive (MiFID) in the UK, JSOX in Japan and Corporate Law Economic Reform Program (CLERP 9) in the Australia.
- EU's privacy restrictions and Massachusetts data protection act, among others.

**Source:** Cloud computing white paper, Mahindra Satyam

- **Regulatory ambiguity, especially internationally:**  
Cloud vendors choose a center for operations which is cost-effective and can support their operations (availability of bandwidth, power, etc.) However, these locations may not be suitable from a customer's point of view due to security and regulatory compliance restrictions. E.g. IT projects in Canada are not allowed to use US-based hosting environments because US has access to all such projects under its Patriot Act which could lead to a breach of privacy.
- **Costs associated with a migration from legacy infrastructure to the Cloud:**  
Large companies may find it difficult to move from legacy infrastructure to the Cloud due to high level of complexity of legacy systems and limited interoperability. Moreover, existing investments in such infrastructure may not provide short to medium term cost benefits. Legacy architecture may not be compatible with virtualized Cloud environments and may involve a time and cost consuming upgrade. Migration challenges are covered in detail in Chapter 4 of this document.
- **Issues of taxation:**  
The Cloud processes need to be monitored continuously to minimize tax exposures and risks. Revenues accrued using the Cloud services may trigger taxation issues in the Cloud service provider's country as well as in the Cloud user's country. E.g. the Cloud allows service providers to provision services over the internet to users in multiple countries. In such a case, the Cloud services offered to a user in another country may be subject to local withholding tax and value-added tax in user's country. Another tax angle can be with respect to location of vendor's servers as tax authorities in some countries can say that profits related to that permanent establishment of server are taxable in their country.



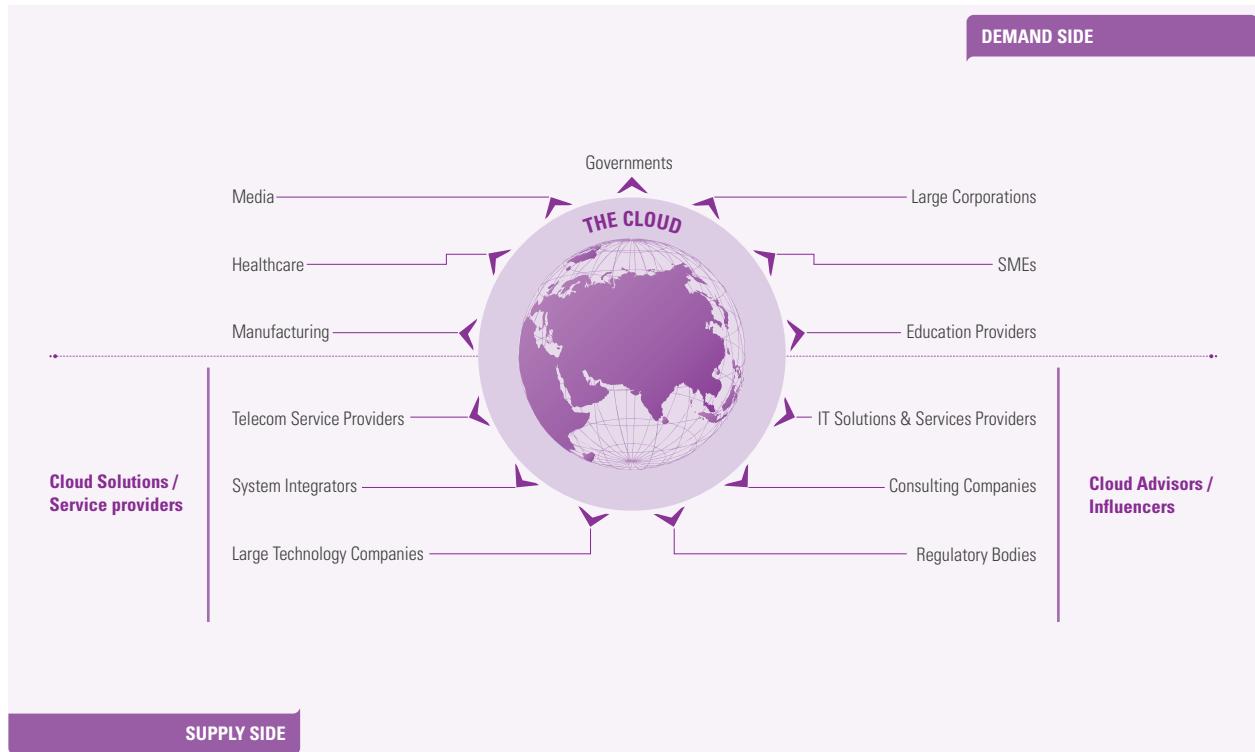


## Impact of the Cloud on the IT ecosystem

The emergence of the 'as a service' paradigm has made the delivery of IT services a utility. At the same time, it would be right to say that the Cloud would rapidly change the way IT is supplied and consumed. The impact of the Cloud is just beginning to be felt. Few areas of the IT ecosystem would be left untouched by this disruptive change. As depicted in the diagram below, the Cloud would impact both the demand and supply side.

**The Cloud ecosystem**

Figure 01



**Source:** Adapted from a thesis titled 'A generic workflow-based model for the deployment problems in grid systems using MPIAB as a case study' by Guruprasad B. Nagaraja

It has been predicted that by 2012, utility and Cloud-based services would account for at least 50 percent of all new demand for managed IT infrastructure services<sup>1</sup>. At the same time, the worldwide Cloud services revenue is forecast to reach USD 68.3 billion in 2010, a 16.6 percent increase from 2009 revenue of USD 58.6 billion<sup>2</sup>. By 2014, services revenue of the Cloud is projected to touch USD 148.8 billion<sup>2</sup>. A large number of IT companies, across the globe, planning to get a piece of the Cloud are now working towards developing or enhancing their Cloud services portfolio.

In this section, we will evaluate the impact of the Cloud on various areas of the IT ecosystem.

- IT service providers
- Datacenters
- Application development
- Solution delivery
- Telecommunications
- Users.

1. ZDNet Asia (Gartner); 'Cloud to make an impact on outsourcing'

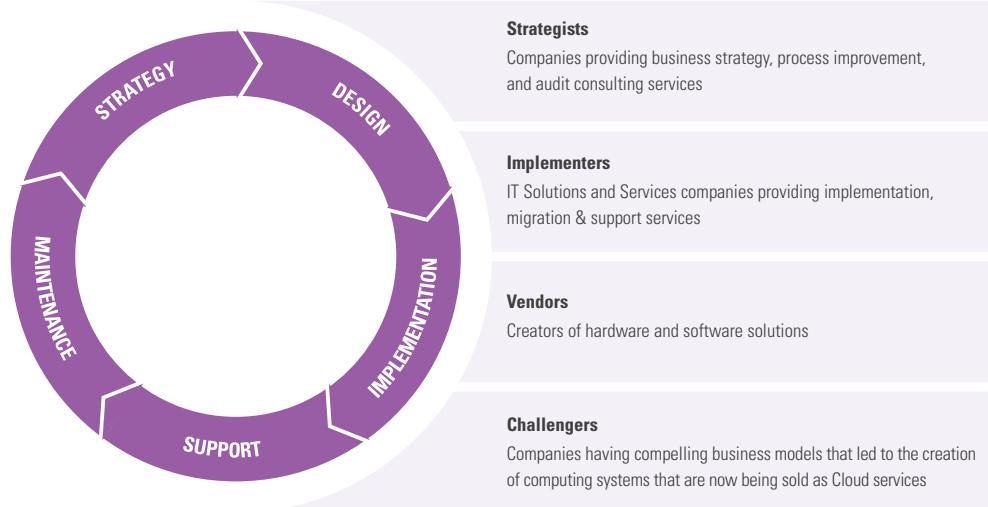
2. Gartner; 'Gartner Says Worldwide Cloud Services Market to Surpass \$68 Billion in 2010'

## Impact on IT service providers

The emergence of the Cloud has impacted the traditional IT services ecosystem through the introduction of a new set of IT service providers identified as 'Challengers'.

**The IT services ecosystem**

**Figure 02**



**Source:** KPMG's The Cloud: Changing the Business Ecosystem, 2011

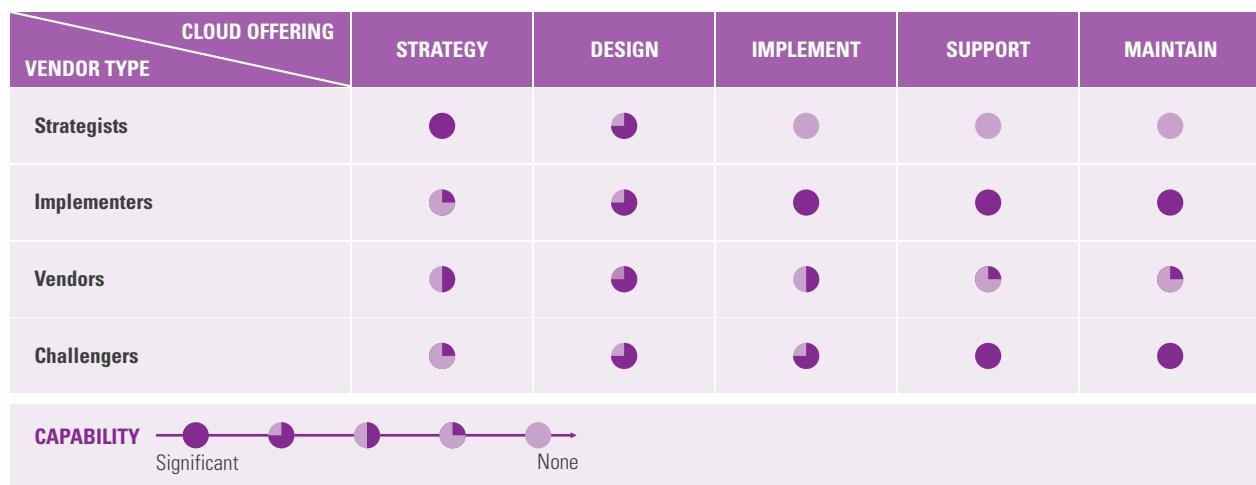
The role of each service provider is as described below:

- **Strategists:**  
Companies that provide IT Consulting services based on their expertise in the areas of business strategy development, business performance improvement, and audit services, etc would be Strategists. These companies also help customers source / develop applications that help meet their business objectives.
- **Implementers:**  
Implementers are the providers of custom application development, application management, implementation, migration, etc. services. In other words, all IT solutions and services companies and system integrators would fall under this category.
- **Vendors:**  
Providers of proprietary computing hardware and software solutions are termed as Vendors. Some of the key vendors include Microsoft, Cisco, IBM, HP, etc.
- **Challengers:**  
Challengers are typically non-IT companies whose business models have required them to innovatively develop and deploy advanced IT solutions and systems. These unique solutions and systems have become compelling business propositions in their own right. Challengers like Amazon, Google, Telecommunication Service providers have moved forward and made available their IT infrastructure and services to external users through the Cloud services model.

The capabilities of each IT service provider are represented as below:

**IT capability evaluation: India perspective**

Figure 03



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

In order to provide services in the Cloud environment, IT service providers would need to enhance their capabilities in areas where they lack the expertise. Capability enhancements could either occur through internal initiatives or externally through the creation of strategic alliances with other service providers.

The advent of the Cloud makes it imperative that IT service providers reassess their capabilities to ensure sustainable growth in the future. As the demand for the Cloud services keeps rising, IT service providers would need to revamp their business processes to not only reflect the impact of the Cloud but also to gain capabilities to provide the Cloud services.

## Data centers

Most data centers are either hosted On-Premise or co-located with third party service providers. CIOs perceive greater control if they themselves own, manage, and control the operations of their data centers. However, there are many challenges associated with the ownership and management of traditional data centers, some of which are provided below:

- ▶ **Challenges associated with existing data centers**
- Power consumption
- Data center management
- Storage management
- Ensuring availability

### Challenges associated with existing data centers

- Power consumption:  
A report by the Environmental Protection Agency (EPA) on energy efficiency in data centers states that energy usage at data centers doubled between 2000 and 2006, and is poised to double again by 2011<sup>3</sup>. The report also highlighted that the US used 61 billion kilowatt-hours of power (1.5% of total production) for data centers and servers in 2006 – a total cost of USD 4.5 billion<sup>3</sup>.
- Data center management:  
Adequate monitoring and management is the primary concern of data center managers<sup>4</sup>. Data centers are getting increasingly difficult to manage on account of the complexity involved. As such, data center managers need to adopt a proactive approach to manage these facilities which requires investments in the form of time and money.

3. ArsTechnica; 'EPA: Power usage in data centers could double by 2011'

4. The 2010 Data Center Users' Group survey

- **Storage management:**

A recent study<sup>5</sup> on enterprise storage needs, highlights that structured data (financial information, inventory details, etc.) would grow at over 20 percent rate over the next five years. At the same time, unstructured data (audio, video, images, etc.) is expected to grow at a 60 percent compounded rate during the same timeframe. In order to continue to meet the ever increasing storage needs of their organizations and customers, IT departments would need to either optimize existing storage or invest in new hardware.

#### **Case Example 01 - US Federal Government**

Over the past decade, the number of data centers operated by the US government increased from 432 to more than 1,200, thus increasing costs related to facilities management and power consumption.

Vivek Kundra who was appointed CIO - US Federal Government in 2009 found that server utilization in most data centers of the US Fed Govt. is around 7 percent. This resulted in some agencies investing in new data centers instead of tapping the 93 percent of capacity available on their existing servers. Mr. Kundra is using these utilization figures to advocate for a shift to the Cloud Computing model.

One of his early Cloud Computing projects has resulted in savings of USD 1.7 million a year. General Services Administration (GSA) which helps manage and support the basic functioning of federal agencies is now hosting the USA.gov federal information portal web site on the Terremark Enterprise Cloud.

The GSA previously paid USD 2.35 million in annual costs for USA.gov, including USD 2 million for hardware refreshes and software re-licensing and USD 350,000 in personnel costs, compared to the USD 650,000 annual cost to host the site with Terremark.

**Source:** 'Data Center Knowledge, 'Kundra: Fed Data Centers 7 Percent Utilized'.

- **Ensuring availability:**

Availability is one of the top three concerns of data center managers as highlighted in a 2010 survey<sup>6</sup>. Data center managers need to ensure that data centers are available for access 24x7. As such, significant investments are made in power backup, load balancing (for peak load management) and cooling systems. Broadly speaking it is essential to build redundancy in all systems needed to run a data center – a reasonably high financial investment.

#### **Benefits of using IaaS for data center requirements**

- A cost effective model
- Businesses are able to focus on core activities
- Management of peak loads
- Incorporates concepts related to green computing

#### **Benefits of using IaaS for data center requirements**

IaaS provides companies the option to outsource data center requirements to service providers. The IaaS model is highly scalable, provides for On-Demand services, and shifts IT expenditure from CAPEX to OPEX.

As a result, the IT departments of companies no longer need to be concerned with the maintenance and up gradation of data centers. Using the Cloud model to fulfill data center requirements enables companies to realize a number of benefits.

- A cost effective model:

IaaS service providers are making large investments in setting up state of the art data centers that would cater to the requirements of thousands of users. Outsourcing data center requirements to the Cloud service providers significantly reduces the outlay on capital expenditure. According to a recent report,<sup>7</sup> the Cloud services are five to seven times more cost effective than traditional data centers.

5. IDC; 'Cloud computing will change data management', Techworld

6. Data Center Dynamics; 'Monitoring/management climb to number-one concern for data center operators'

7. University of California; "Above the Clouds: A Berkeley View of Cloud Computing"

- **Businesses are able to focus on core activities:**

Using the Cloud service providers for data centers ensures that Senior Executives are focused on activities related to the company's core business. Key IT management personnel that were earlier locked into managing data centers are thus able to focus on making innovative use of IT for business needs. Some of the tasks that are automated and managed by the Cloud service providers include the following:

- Storage, backup and archiving of data
- Security-related hardware and software implementation & upgradation
- Up grade and the monitoring of hardware infrastructure
- Load balancing, remote access control and management tools
- Capacity planning and storage management

IaaS providers offer customers varying degrees of administrative control over their infrastructure through a unified Web portal. Ownership rights, governance and external monitoring requirements are agreed upon by both service provider and the customer through the signing of Service Level Agreements (SLAs).

- **Management of peak loads:**

Peak demand can be easily managed through the use of IaaS without additional investment in resources. There are techniques that can be used to allocate computing resources on peak loads. The Cloud model ensures the mitigation of these issues while providing the ability to seamlessly scale services up and down.

- **Incorporates concepts related to green computing:**

The emergence of IaaS services has directly contributed to the growth of green computing. Green computing refers to environmentally sustainable computing or IT. It involves the use of technologies like virtualization, and solutions that help monitor and regulate energy usage at data centers to reduce power consumption. Consequentially, the use of green computing is encouraged by both - service providers and companies as a way to achieve environmental and cost benefits.

## Application development

The use of Platform as a Service (PaaS) for software development enables developers to quickly design, develop, and test solutions to be deployed on the Cloud. As a result, developers save on costs, in the form of time and money, needed to source and maintain the infrastructure needed for development. Windows Azure, Google App Engine, Zoho, and Force.com are some of the leading providers of PaaS.

### Challenges associated with the traditional application development model

- Infrastructure requirements and associated costs
- Lead time for the setting up of development and test environments
- Service orchestration
- Simple application development

### Challenges associated with the traditional application development model

The traditional application development model has been serving organizations for a long time. However, there are several inherent challenges associated with this model.

- **Infrastructure requirements and associated costs:**  
Computing infrastructure like servers, storage systems, and application development tools are needed for software development. Most applications are developed in one environment, tested in another, and then redeployed in an altogether different environment for production. As a result the investments needed for the creation of a suitable application development environment are extremely high.
- **Lead time for the setting up of development and test environments:**  
There is typically a large lead time for creation of development and testing environments for applications. This adds up to the overall time needed for application development which in turn may lead to the organization missing out on achievement of its business objectives. E.g. an organization may seek to capitalize on a window of opportunity by leveraging an IT application. However, due to the large lead time, it may not be able to do so.

- **Service orchestration:**  
Traditional application made it difficult for developers have an automated arrangement, coordination, and management of complex computer systems, middleware, and services especially between systems of business partners. While concepts like Service Oriented Architecture (SOA)<sup>8</sup> and Business Process Execution Language (BPEL)<sup>9</sup> have been around for a while, lack of an appropriate platform to enable full exploitation of their potential did not exist.
- **Simple application development:**  
Traditional application development required developer time even for simple applications e.g. Leave Management System. This led to avoidable development costs for even simple applications. Most of the traditional application development platforms did not offer simple interfaces to enable end users to develop their own applications.

#### Benefits of using PaaS for application development

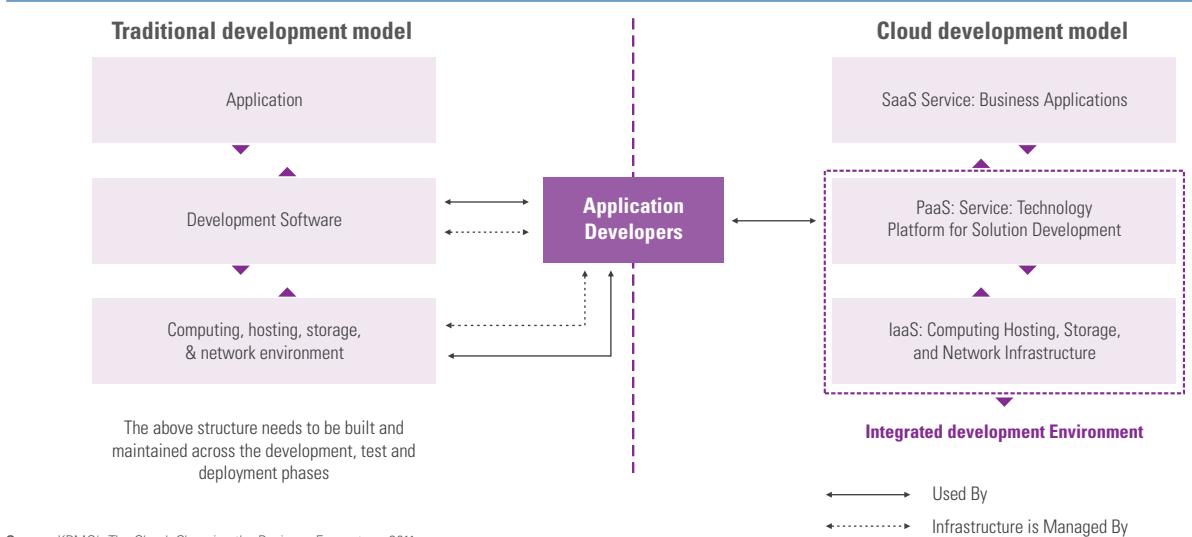
- Infrastructure is managed by the service provider
- Time to implement is shorter
- Use of Application Programming Interfaces (APIs)
- Increased focus on development
- Innovation and entrepreneurship

#### Benefits of using PaaS for application development

- Highly scalable and robust web-based applications can be built using PaaS. An Integrated Development Environment (IDE) consisting of hardware and software resources is provided by service providers for application development. Developers can easily choose and deploy the IT hardware and software environment they want to develop their solution in. Platform services are primarily used for:
- Developing new software solutions / business applications
  - Modifying applications / interfaces that are made available by SaaS service providers – such applications have their own PaaS system

### Comparing the traditional and the Cloud development models

Figure 04



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

- **Infrastructure is managed by the service provider:**  
PaaS providers make available a range of hardware and development software for software developers to choose from. PaaS can be used to either develop new solutions or to modify existing SaaS solutions. In the case of the former, developers can choose technologies and systems as required based on a Pay-as-you-go model. If an existing SaaS solution needs to be modified then the SaaS provider would have a PaaS platform that can be used to further develop / modify the existing features of the solution. The task of upgrading, and managing the hardware and software environment needed for solution development, is the responsibility of the PaaS provider.

8. Refer to glossary  
9. Refer to glossary

- **Time to implement is shorter:**  
PaaS provides application developers the flexibility to rapidly develop and deploy custom applications. Applications developed using PaaS have the advantage of being developed and tested in an environment that is similar to the production environment. As a result, developers can run test cases on the solution as soon as it is ready, debug it and then deploy the same. This significantly reduces the costs and time associated with testing and deployment.
- **Use of Application Programming Interfaces (APIs)<sup>10</sup>:**  
APIs are a set of rules and specifications that enable developers to connect to and use databases being used by existing SaaS solutions. SaaS providers make APIs available to developers so as to increase the popularity of their service through the customization of user interfaces. E.g. a majority of the listings (approximately 60 percent) on Ebay.com are done through the use of APIs<sup>11</sup>.
- **Increased focus on development:**  
The use of APIs provides developers with the flexibility and time needed to focus on solution development. Overall, the use of PaaS enhances productivity and ensures a focus on solution development.
- **Innovation and entrepreneurship:**  
According to a study by NASSCOM, the entry barrier for entrepreneurs in the field of proprietary software development is now lower due to the availability of PaaS<sup>12</sup>. Entrepreneurs can design, develop and provide access to SaaS solutions based on the Cloud in shorter timeframes and with significantly lower seed investments. The study also indicated that the global PaaS market is growing at over 160 percent indicating the increasing acceptance of the PaaS model. As an offshoot, it is expected that software innovation would be a beneficiary.

#### Case Example 02 - Social Education and Development Society (SEDS)

SEDS is an India based NGO that works with over 40000 people across 250 villages in the Anatpura District, Andhra Pradesh. The NGO which had a minimal IT budget wanted to develop a Cloud based Census Information Management System (CIMS) to help automate the process of data gathering. The solution also needed to help collect and analyze information more accurately.

The NGO decided to use the PaaS platform provided by Wolf Frameworks to build the application. SEDS did not have any IT programmers but was able to build the application in 120 hours using a point-and-click design environment. The application can be used from low bandwidth internet connections and allows for the addition of new surveys and analytics. The infrastructure requirements for this application were restricted to a desktop, browser, and internet connection.

The CIMS application is used to store and manage data of 250 villages, 980 self help groups and auto generates User Identification Numbers (UIDs) for more than 40,000 individuals. The solution is also able to scrutinize and generate analytics based on historical data of the last 15 years.

**Source:** InformationWeek, 'Mini UID SaaS project blooms on cloud computing platform'

## Solution delivery

Software has traditionally been used by companies to meet the automation and reporting requirements of businesses. Supply Chain Management (SCM), Human Resource Management (HRM), Financial and Accounting Solutions, Customer Relationship Management (CRM), etc are only a few examples of the type of solutions that have been employed by the industry. A majority of these solutions are currently being hosted On-Premise.

10. Refer to glossary

11. DevEx; 'The Rise of APIs – Lessons from the Cloudstock Conference'.

12. NASSCOM; 'Global SaaS opportunity, including Platform-as-a-Service (PaaS) and Infrastructure-as-a-Service (IaaS), to exceed USD 30 billion by 2012'.

The recent economic downturn has warranted that organizations think twice about the sourcing and developing of On-Premise applications – primarily due to high capital investments. User requirements are also changing drastically especially with regards to the way applications are being accessed/used and the type of output that is now sought.

Developers using the traditional software development model are hard pressed to provide solutions that meet the continually changing requirements of today's users while keeping costs at a minimum.

#### **Challenges associated with the use of the traditional software delivery model**

- Software licensing fees
- Need for a hosting environment
- Software maintenance requirements
- Need for in-house IT teams

#### **Challenges associated with the use of the traditional software delivery model**

- **Software licensing fees:**  
Software licensing is one of the major costs in IT Procurement. A software license permits users / businesses to implement one or more instances of an application based on a pre agreed fee. In the case of large businesses, the management of software licenses is a concern as they either tend to buy extra licenses for future requirements or under utilize the existing ones. Moreover, software licenses once bought cannot be returned. Consequently, changing business requirements and a need to cut costs is resulting in the demand for flexible pricing models that are based on monthly usage or any other similar metric<sup>13</sup>.
- **Need for a hosting environment:**  
Traditional software, also identified as On-Premise solutions, require a hardware and software environment to be deployed. The sourcing and management of this environment is an expensive proposition for most users especially for large businesses who need to invest in data centers.
- **Software maintenance requirements:**  
Application or software maintenance is carried out to remove bugs or modify existing solutions based on changing business requirements. Companies either build in-house teams or outsource application maintenance requirements to IT solutions and services companies. In the case of large corporations, such outsourcing contracts are generally multi-year agreements that run into millions of dollars in fees. Additionally, application maintenance also requires development and testing environments piling onto costs.
- **Need for in-house IT teams:**  
Companies that have a large number of applications invest in employing trained personnel to manage the same. The costs of hiring, training, and managing IT personnel are significantly high for non-IT companies.

#### **Benefits of using the SaaS model for solution delivery**

- Economies of scale
- Multi-tenant architecture
- Rapid deployment
- Usage based metrics
- Access on the move

#### **Benefits of using the SaaS model for solution delivery**

Research predicts that by 2012 more than 33 percent of independent software vendors (ISVs) would offer some of their applications optionally or exclusively as SaaS<sup>14</sup>. The worldwide SaaS revenue within the Enterprise Application Software market is also expected to surpass USD 9.2 billion in 2010, which is an increase of 15.7 percent over the previous year<sup>15</sup>.

- **Economies of Scale:**  
SaaS providers are able to make available solutions at more affordable rates as customers are being provided access to a single deployment of the solution. As a result, vendors experience cost benefits with regards to application deployment, maintenance, and hardware infrastructure which are passed on to the customer. Notably, SaaS providers can almost instantaneously pass on the benefits of software upgrades to customers as they need only be reflected in the core deployment of the solution – accessed by all.

13. Channel Insider; 'IT Cloud Disruptive to Outsourced Services Market'

14. Gartner

15. Gartner; 'Gartner Says Worldwide SaaS Revenue Within the Enterprise Application Software Market to Surpass \$8.5 Billion in 2010' / 'Gartner Says SaaS Revenue Within the Enterprise Application Software Market to Total \$9.2 Billion in 2010', Gartner, Inc.

- **Multi-tenant architecture:**  
Multi-tenant architecture signifies the use of a single instance / deployment of software to serve the application needs of multiple companies and multiple users within each company. The development of software based on multi- tenant architecture results in a highly scalable solution that optimizes the use of existing computing infrastructure resulting in cost benefits for the end user.
- **Rapid deployment:**  
On-Demand solution is a term that is being increasingly used to identify applications made available through SaaS. The lead time (the time taken from requirement identification to actual solution deployment) in the case of SaaS solutions is very small in comparison to the lead time taken currently. Companies that intend to implement a SaaS solution go through a three stage process.
  - Selection – Evaluation of existing solutions, selection and signing of SLAs
  - Deployment – Customization of the selected application, if required
  - Management – Monitoring SLAs signed with the service provider
- **Usage based metrics:**  
The pay-per-use or pay-as-you-go pricing model of SaaS enables customers to scale up or down usage requirements without having to worry about IT hardware and procurement of software licenses. In other words, companies only pay for the number of active users of the SaaS service. Companies would not need to invest in acquiring computing systems and bulk licenses to cater to the projected rise in the number of employees.
- **Access on the move:**  
SaaS solutions are highly versatile and can be accessed through the internet from across the globe. A majority of SaaS solutions that are developed have user interfaces that are designed to work across screens of different sizes on computer or mobile systems.

## Impact on enterprise networks / telecom service providers

Prior to the emergence of the Cloud, businesses were focused on developing and maintaining a strong internal network. Data centers hosted the applications and data necessary for day-to-day operations while access to the same was provided through the creation of robust internal networks. With the Cloud, the onus of providing connectivity to core business applications, real time information, Voice over IP (VoIP) services etc has now shifted to external networks. As a result, telecommunication service providers who are primarily responsible for providing connectivity and maintaining external networks would play a key role in providing Cloud based services. The availability of a robust external network that provides for high bandwidth at low costs would be essential for the success of a Cloud implementation.

### Network related concerns for the Cloud

- Ensuring availability
- Governance of SLAs
- Prioritization of services
- Dependence on service providers

### ► Network related concerns for the Cloud<sup>16</sup>

A shift to the Cloud is expected to reduce concerns related to the sourcing and management of IT infrastructure. At the same time, due to an increased dependence on external networks for the delivery of computing services it is expected that IT Managers would have to increase their focus on the services being provided by telecommunication service providers. Developing a network management strategy that recognizes the requirements of organizational users of the Cloud would be essential to ensuring seamless delivery of services. Following are some of the key concerns related to the management of external networks:

- **Ensuring availability:**

A shift to the Cloud would require an increased monitoring of network traffic. Network managers would not only have to monitor internal networks to identify performance issues but also external networks in order to ensure the availability of service.

16. IPEXPO.ONLINE; 'Five Ways the Cloud Impacts the Network', 'Preparing Your Network for Cloud Computing', Telnet Networks News 'State of the Network', Network Instruments

- **Governance of SLAs:**

Enforcing SLAs signed with the network service provider would be essential to ensure availability. SLAs are used to define expected bandwidth levels, availability, peak demand levels, pricing, service response time etc. Businesses would need to build internal teams or hire third party auditors to monitor SLAs signed with external network providers.

- **Prioritization of services:**

As users shift to an On-Demand environment, it would be essential to determine which applications and users get priority to receive bandwidth. A shift to the Cloud would not be beneficial, if a few users / non-core applications end up using a majority of the available bandwidth. Managing demand for increased bandwidth by sourcing more bandwidth from service providers would only drive up costs. IT Managers need to take a hard look at current / expected usage patterns in order to prioritize bandwidth access.

- **Dependence on service providers:**

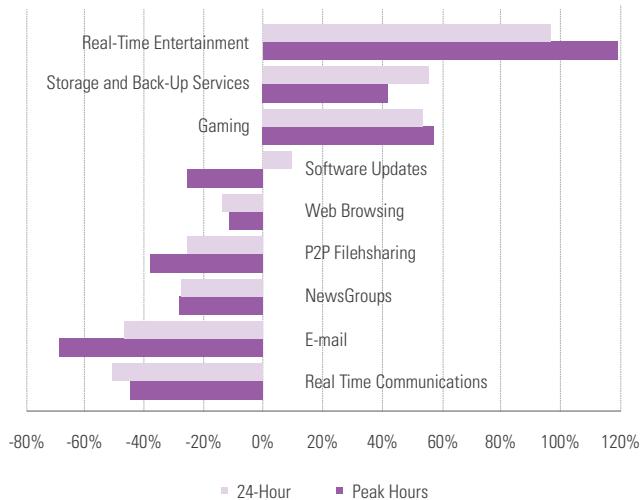
The Cloud might not be accessible in case there is a fault in the external network. Financial losses experienced due to non-availability of core applications would be a serious concern as it could impact business processes and productivity. As such, businesses would be dependent on external network providers to ensure business continuity.

## Changing role of telecommunication service providers

A recent research indicates that On-Demand traffic dominated the global internet bandwidth load in 2009<sup>17</sup>.

Telecom service providers are the primary providers of connectivity services to retail and business clientele. As such, the growth of the Cloud presents a tremendous opportunity for telecom service providers as they are instrumental in providing last mile connectivity to clients.

**Aggregate bandwidth share change  
(2008 to 2009)**



**Figure 05**

Telecom companies are experienced in managing large data centers, metering solutions, and support services that cater to a large pool of customers.

At the same time, they can also leverage their wide reach to become resellers by obtaining bulk deals from providers of Cloud services. They can easily move up the value chain thereby monetizing their existing infrastructure and bandwidth backbone. Hence, the advent of Cloud services presents telecom operators with the dual option of either becoming resellers of the Cloud or providing their own Cloud services to customers.

Telecom service providers have begun offering a range of Cloud services either by leveraging the services of existing Cloud service providers or providing their own. These companies include:

- AT&T (USA) which is providing customers with 'Compute as a Service' which lets businesses rent more computing capacity when they need it<sup>18</sup>
- Vodafone which provides a Cloud service called Vodafone PC Backup which has been launched in partnership with Decho, a subsidiary of storage firm EMC<sup>19</sup>

- Tata Communications which launched a Cloud service called InstaCompute that enables users to buy processing power, storage capacity, basic office applications for word processing, or email services<sup>20</sup>

17. TMC Net ; 'On-Demand Traffic Dominates Internet Bandwidth'

18. CNET News; 'AT&T expands its cloud service'

19. Telecoms.com; 'Vodafone sees silver lining in cloud computing'

20. Livemint.com; 'Tata Communications launches cloud computing service'

## Users

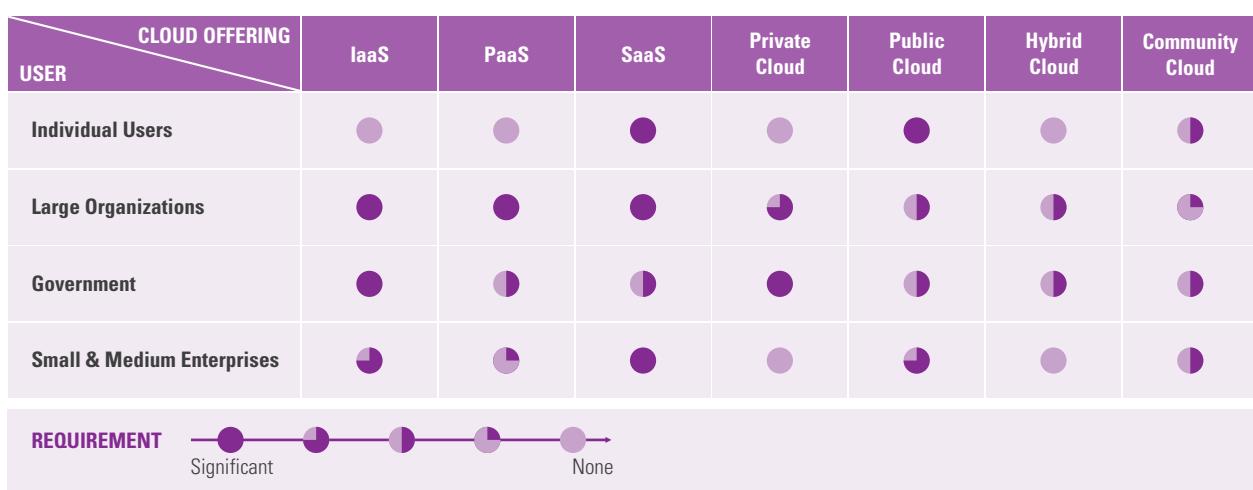
The Cloud initially meant IaaS, however, over the last couple of years this definition has expanded to include PaaS and SaaS.

The mobile and dynamic access to content provided by Cloud-based services like social networking and content collaboration platforms (e.g. Facebook, Twitter, Google Docs, etc) led to a large number of people using these services. Enterprise workers are now demanding a similar level of sophistication and flexibility from the business applications that they use.

The adjoining figure presents an analysis of the significance of Cloud service and deployment models for different user categories.

User requirements - Cloud services

Figure 06



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

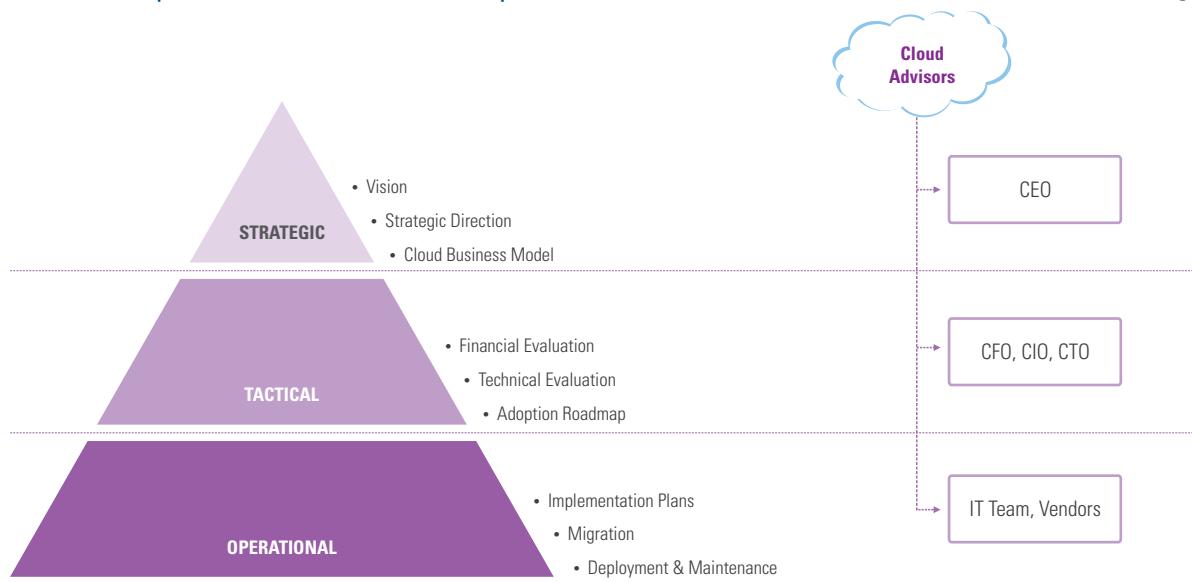
- **Individual users:**  
Private Clouds are an expensive proposition and as such the individual user would be primarily concerned with the public Cloud. Similarly, the use of SaaS services amongst the members of the general public is expected to be the highest. Examples of Cloud services being used by the individual user include Google Mail, Facebook, Amazon EC2, Google Docs, etc. A majority of the Cloud services targeted at the individual user by service providers are provided under the freemium banner. Freemium is a business model wherein the basic features of an application are freely available while access to advance features is limited to subscribers.
- **Large organizations:**  
Concerns related to data security coupled with the benefits of IaaS services could result in a majority of large organizations (global MNCs) deploying their own private Clouds. Similarly, features of SaaS and PaaS services like Pay-as-you-go, On-Demand availability make SaaS and PaaS the other services that would be widely used amongst large corporations.
- **Government:**  
Data Security requirements are stringent in the Government sector. Considering the type of requirements and the number of people that would be accessing services from a Government Cloud it seems imperative for Governments to deploy private Clouds, primarily to provide IaaS services. The importance of the other Cloud Services to be used by Governments would differ on a case-to-case basis.
- **Small & Medium Enterprises (SMEs):**  
A lack of cost effective / quality applications in the market that would enable SMEs to better manage their businesses would result in SaaS applications being adopted by SMEs. Companies that belong to the SME category are expected to make the most use of public Clouds as they would lack the financial investments needed to setup and maintain private Clouds.

## Role of the leadership in managing the cloud

Implementing the Cloud is largely a strategic business decision rather than a purely technology decision. It is driven by business needs and financial considerations. At first glance, while it seems to be largely the domain of the CIO, deeper understanding of the Cloud paradigm indicates that business leaders have a major role in adoption of the Cloud. As it is with any business and technology initiative, the adoption of the Cloud would have to be addressed at all levels of the organization viz. Strategic, Tactical and Operational. The responsibilities at each level are as depicted below:

**Roles and responsibilities of the leadership**

Figure 07



**Source:** KPMG's The Cloud: Changing the Business Ecosystem, 2011

Indicative roles and responsibilities for the senior leadership with respect to the Cloud at each level are as follows:

- Strategic level:**

The Cloud offers promises to have an impact on usage of IT by organizations both in terms of its own internal usage as well as how it uses IT to service its clients.

At a minimum, the Cloud promises to cut internal IT costs while increasing scalability and availability of IT resources. On the other end of the spectrum, one that is exciting for strategic business leaders like CEOs is the possibility of using the Cloud to support new business models. Due to the short time to market and flexibility of the Cloud, CEOs can today think of scenarios where IT can be used innovatively to enhance existing services and even radically change its delivery model.

As part of the CEO's strategic role for adoption of the Cloud, he would do well to consider not just how the Cloud could be leveraged internally but how it could help radically alter its very business. Consequently, many companies would need to modify their business strategy to realize the benefits of the Cloud. This is especially true for companies that belong to customer centric industries like Media & Entertainment, Education, and Government.

- Tactical level:**

As part of the tactical responsibility for the adoption of the Cloud, the CFO and CIO are expected to play complementary roles.

CIOs are expected to play a leading role in the evaluation of Cloud offerings and recommending a technical roadmap for adoption of the Cloud. CIOs would also play a major role in developing Total Cost of Ownership (TCO) and Return on Investment (ROI) analysis as part of adoption of the Cloud. Further, the CIO would largely be responsible for developing a Cloud adoption roadmap.

On one hand CFOs would play a key role in the financial evaluation of the adoption of the Cloud. This would mean an assessment of the business case from a financial perspective and also other relevant issues like tax concerns. The CFO could largely serve as a key intermediary between the CIO and the CEO enabling reduction of IT costs.

On the other hand he or she could also act as a facilitator for implementing newer business models using the Cloud.

- **Operational level:**

At the operational level, the IT team and vendors would play a key role in Cloud implementation. This would involve drawing up detailed project plans for implementation, migration and deployment. Cloud migration is one of the areas that require close attention due to the possibility of project overruns. IT team and vendors would need to work closely to enable quick migration to the Cloud. Further, the IT team would need to liaise with vendors on an ongoing basis to ensure high performance and availability of the Cloud. This would involve SLA management, vendor management and performance monitoring by the IT team.

- **Cloud advisors:**

While organizations have much to gain from adoption of the Cloud, the dynamic nature of the Cloud market necessitates the use of advisors of the Cloud to help during the process of adoption of the Cloud. These advisors of the Cloud could play a significant role in assessing the organizations readiness for the Cloud and thereafter helping to develop a roadmap for its adoption. Further, advisors of the Cloud could also handhold organizations in the actual implementation process thereby reducing the project risk.

Another area where advisors of the Cloud would be seen to play a major role is assisting organizations to leverage the Cloud to change or enhance their business models. They could assist organizations to create new service models thereby triggering a radical change in the sector within which the organization operates.





# Impact of the Cloud **on the industry and the user market**

## Introduction

In today's economic climate, while organizations are dealing with dynamic markets and ever-imposing regulations, CIOs are dealing with increased expectations from businesses and diminishing IT budgets. Business heads are under constant pressure to implement cost-efficient strategies that enhance business performance i.e. to do more with less. The adoption of the Cloud is expected to open up new investment and business opportunities currently obstructed by a surmounting need for huge up-front IT investments.

An easy, fast and economical access to computing solutions, made possible through the use of a virtual technology environment, is attracting the business world to the Cloud. Pay-as-you-go subscriptions, online storage, and the outsourcing of the management of IT infrastructure (a feature of the Cloud) support flexible business models which allow firms to scale their businesses as per demand.

The Cloud promises to be a computing services model that is not restricted to a particular industry. This is why the Cloud is a compelling proposition even for those industry verticals that have not traditionally been at the forefront of IT adoption such as the Government, Healthcare, and Education industries.

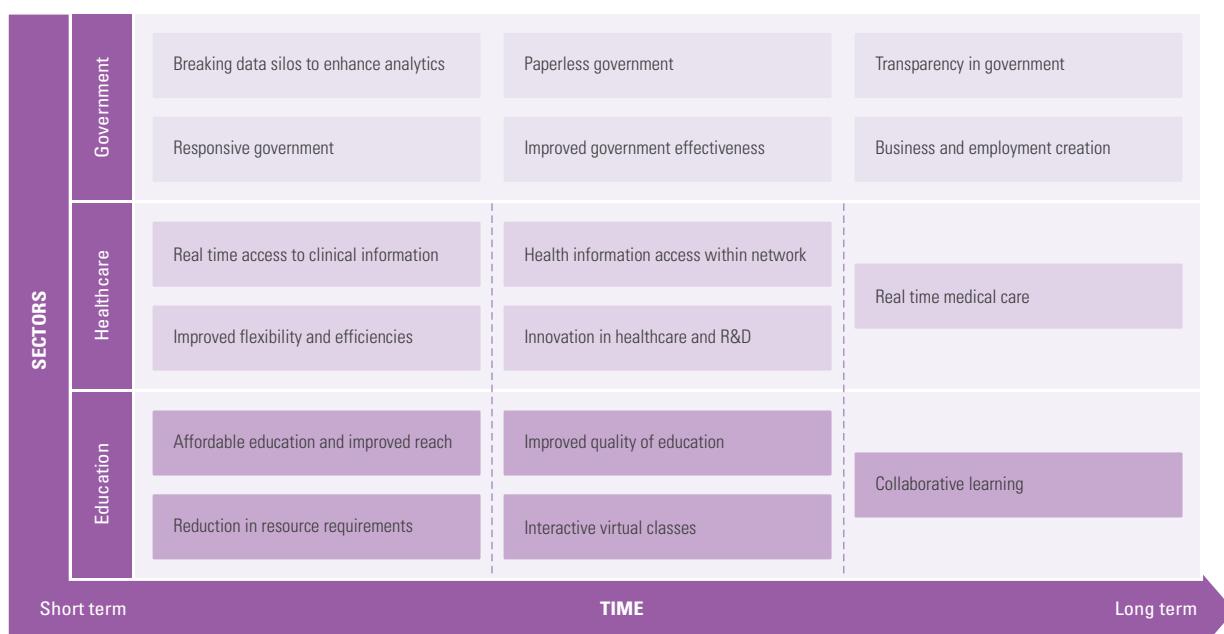
In this section, we have analyzed the possible impact of the Cloud on three key sectors viz. Government, Healthcare, and Education and the Small and Medium Enterprises (SMEs) user group. The Cloud promises to radically change the way in which these sectors operate and have a lasting socio-economic impact. While these sectors have been taken as examples, the Cloud promises to affect other sectors in a similar manner.

## The user market

Flexibility, interoperability and scalability are some the benefits of Cloud services that would be commonly experienced in any industry sector. At the same time, there are certain applications of the Cloud that have the potential to revolutionize certain industries in the longer term.

**Benefits of the Cloud across select sectors**

Figure 01



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

- **The Government sector:**

With an increasing demand for transparency in government, eGovernance is being adopted by public authorities across the world.

In order to not only enhance the effectiveness of eGovernance but also to experience cost benefits, countries such as USA and UK have defined the Cloud as an integral part of the government's IT strategy<sup>1</sup>, and are gradually moving towards a nearly paperless government.

However, the traditional model of governance is still prevailing in countries such as India. These models restrict the process of bringing government services closer to the public, thereby giving rise to operational inefficiencies, cost overruns, ineffective communication, and data duplication.

The Cloud provides public agencies with distinct advantages to meet new 'open' government requirements. Cloud services make available an environment that provides government agencies with access to a shared pool of easily usable computing resources (such as hardware and software). As these benefits directly impact the effectiveness of governance, the Cloud has gained the attention of government agencies the world over.

- **The Healthcare sector:**

The Healthcare sector spends around USD 5 trillion on healthcare services. However, just 2 to 3 percent of the operating budgets of healthcare providers are spent on IT systems<sup>2</sup>. Also, healthcare service providers are primarily concentrated in urban areas depriving those patients that live in rural areas of quality healthcare. This lopsided ratio is expected to change soon as the industry could transform with the emergence of the Cloud.

Similarly, digitization of health information is being seen as a means to provide rapid and timely healthcare services along with improved quality of care. At the same time, lower Research and Development (R&D) budgets are forcing drug manufacturers to look at cheaper computing alternatives. The Cloud is being seen as a solution to such issues.

Healthcare providers have already started experimenting with private Clouds while a few are using public Clouds as well. However, data security and privacy protection issues have kept several players from adopting the Cloud. Even though the use of Cloud services in healthcare is at a nascent stage the future seems to be very promising with its adoption increasing globally.

- **The Education sector:**

The last decade has seen the education sector make tremendous advances in meeting its social and business goals. Technological breakthroughs and the evolution of new teaching methodologies are greatly improving the reach of education.

However, the recent recession has threatened to impact this progress while also having the potential to actually reverse positive trends. Increasing cost of education, and shrinking financial support are a few factors adversely affecting the education sector.

In this scenario, the Cloud appears to be just the solution needed. Besides being cost effective, the Cloud is also expected to reduce issues related to the sourcing and management of IT infrastructure of schools and universities, allowing these institutes to concentrate on their core competencies.

Though the education sector has been cautious / conservative in adopting new technologies, the Cloud presents benefits that cannot be ignored. The Cloud in the education sector could shorten the timelines that are required to realize the goal of 'Education for all' and quicken the building of 'Meta-universities'.

- **Small and Medium Enterprises (SMEs):**

As users, the SMEs in particular are expected to benefit the most from the Cloud. This is primarily because they are unable to make high up-front investments required for the setup of traditional IT systems and solutions. The Cloud gives SMEs the ability to source high end computing solutions in an environment that is based on utility computing. SMEs are also adopting Cloud services to gain greater agility.

1. The World Bank, Next Generation eGovernment: The Cloud and Beyond, eGovernment Summit  
2. Healthcarecompetitiveness.com, Article: Export growth potential for US healthcare companies; allbusiness.com, Article: The myths of benchmarking healthcare IT spending, October 2006

The worldwide SME spend on the Cloud is expected to reach USD 100 billion by 2014<sup>3</sup>. Five market segments viz. business applications, application development/deployment, system infrastructure software, storage and servers, are expected to be the key areas of spending<sup>4</sup>.

The following parts of this section present an overview on the adoption of the Cloud and its impact on the aforementioned user markets.

## Cloud for government

### Introduction

Traditionally, government services have been delivered in a brick and mortar environment, which has restricted the reach of these services to only a few sections of society. This is especially the case in developing countries like India where the socio-economic disparities and population restrict the efficacy of government services in the traditional model.

The traditional government environment in India has been based on files and individuals, with work proceeding along traditional hierarchical lines. This has caused the general public to experience delays, duplication of effort, etc.

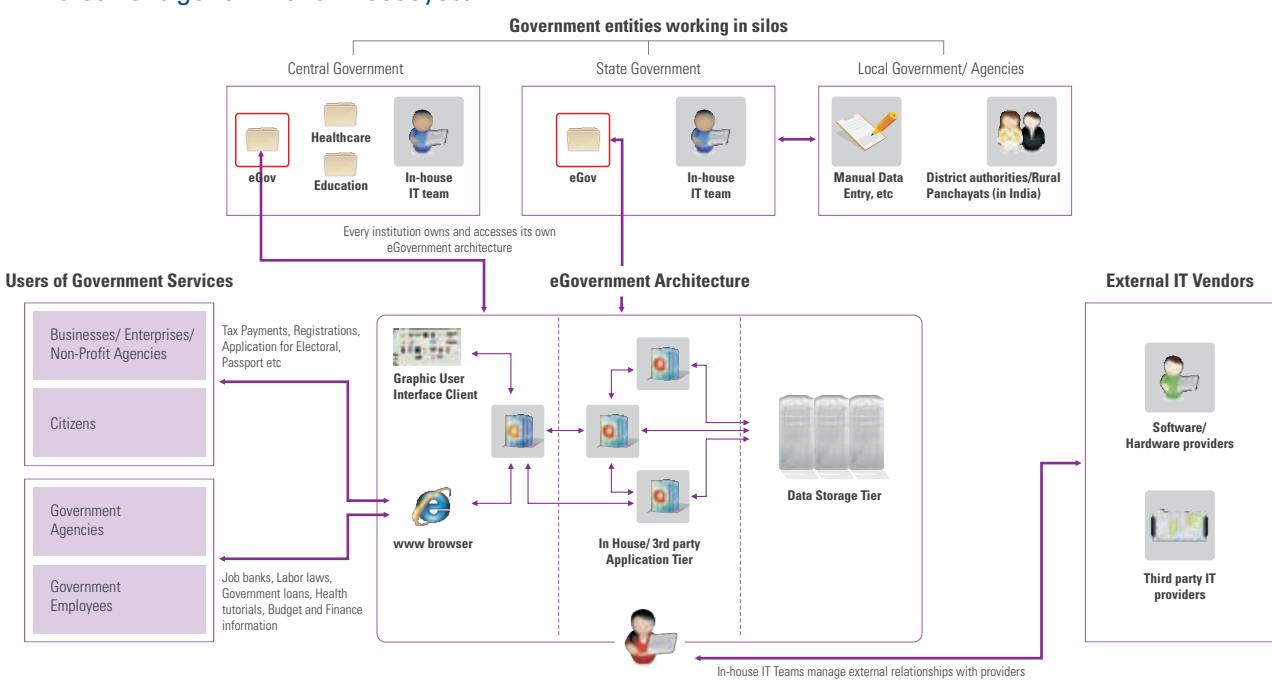
Governments worldwide have a common vision to deliver efficient, transparent and On-Demand services to citizens and businesses that could be available to them at any time and any place.

### Current role of technology in government

IT can play a significant role in building accountable and democratic governance institutions. Strategic application of knowledge and innovative use of available technology is now being made to provide governance services to all sections of the society.

### The current government IT ecosystem

Figure 01



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011, ijcaonline.org

3. AMI Research

4. Smetimes.tradeindia.com; 'Cloud computing allows smbs to scale their computing capabilities'

Global shifts towards the increased adoption of IT by governments started in the nineties. The aim was to not only improve government efficiency and services delivery, but also to promote an increased participation of citizens in various governance and democratic processes. This provided a transparent channel for interaction between the government and citizens, promising the achievement of the goals of good governance.

With an increasing demand for transparency and accountability in government work, the Right to Information was a natural progression for governments. India's Right to Information Act (RTI), adopted in 2005, was modeled on the United States' Freedom of Information Act. Within the first two and half years of existence, Indian citizens have filed about 2 million requests for information under the RTI, Act<sup>1</sup>.

<b>eGovernance includes:</b>
<b>eAdministration</b> The use of ICT for state modernization: Digitization of records, data repository creation for MIS
<b>eServices</b> Giving access to the citizens, bringing the state closer to the citizens: Providing online services
<b>eGovernance</b> Using IT to improve the ability of government to address the needs of society, for strategic planning and achieving development goals: transacting with citizens through information portals, etc.
<b>eDemocracy</b> Using IT to facilitate the participation of all sections of society in the governance of the state, with an emphasis on transparency, accountability and participation: Online disclosure policies, online grievance redress forums and e-referendums

The main drivers of eGovernance are to achieve the goals of efficiency and effectiveness in government processes. eGovernance uses the IT systems and tools to provide better services to citizens and businesses. These tools also facilitate the process of bringing the government closer to the people. This is primarily possible through major improvements in the way government services and information are provided to people and businesses alike.

Public services delivered through electronic media, such as the Internet, bring potential benefits such as transparency in government processes and the marginalization of middlemen. Processing documents, such as licenses, or collecting taxes electronically are a few examples of services that could be easily executed through the web.

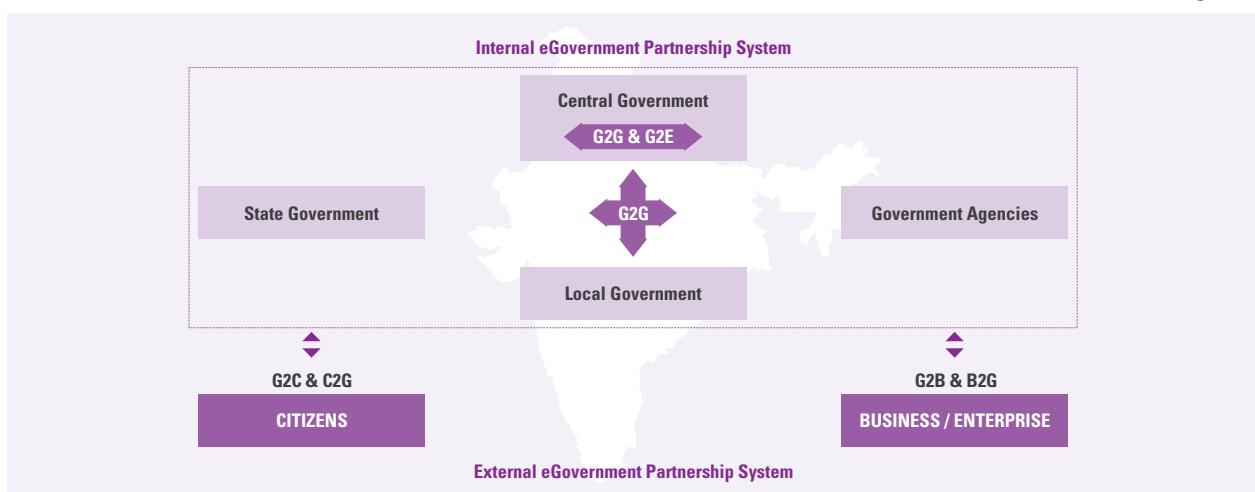
According to a World Bank research article titled 'Enabling eGovernment in developing countries: from vision to implementation', the implementation of eGovernance solutions in India in areas such as the issuance of land records for farmers, the payment for public utility services, etc. would make the entire process more predictable for users. At the same time, the citizens' cost of accessing such services would significantly decrease.

#### eGovernance interactions

eGovernance services focus on four main categories of users: citizens, the business community, government employees, and government agencies.

### Government interactions

Figure 02



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011, thegovmonitor.com

1. Suffolk University; 'A Great and Revolutionary Law? The First Four Years of India's Right to Information Act'

- **Government to Citizens (G2C):**

G2C services include the provisioning of facilities related to license renewals, application of certificates such as birth, death or marriage and filing of individual income taxes. It further includes assistance on basic services such as education, health care, land records, libraries, etc. The Right to Information Act would also be primarily used by citizens as a part of this interaction.

#### **Case Example 01 - Singapore adopts eServices for its citizens**

Through Singapore's eCitizen portal, the citizens were able to access about 1,600 e-services pertaining to business, health, education, recreation, employment, and family. Out of these, about 1,300 eServices could be transacted completely by citizens with government online. Some of the popular eServices being used are: submission of application forms for real-estate and apartment purchase, searching for information on schools, employment opportunities, career development, and voter registration. By June 2002, about 77 percent of public services deemed feasible for eDelivery were enabled for online delivery.

**Source:** ica-it.org

- **Government to Business (G2B):**

G2C services include the provisioning of facilities related to license renewals, application of certificates such as birth, death or marriage and filing of individual income taxes. It further includes assistance on basic services such as education, health care, land records, libraries, etc. The Right to Information Act would also be primarily used by citizens as a part of this interaction.

- **Government to Government (G2G):**

G2G services are transactions between the various departments and agencies associated with the Central, State and Local governments. At the same time, G2G services could also be transactions between the governments of countries across the globe that could be used as an instrument to facilitate diplomatic relations.

- **Government to Employee (G2E):**

Government employees are an important component of facilitating the delivery of services. 'G2E services' encompass 'G2C services' as well as specialized services that are meant for government employees only. These specialized services include imparting of trainings and services to employees that would improve the government's day-to-day functions and dealings with its employees.

#### **Case Example 02 - Mississippi State Government adopts eGovernance to benefit their employees**

In October 2002, Mississippi state government put payroll and tax information records online for their employees who could view these through a secure, web-based application called Access Channel for Employees (ACE). This self-service application has saved the state of Mississippi USD 0.50 for every W-2 form (which is a form that an employer sends to an employee and the IRS at the end of the year) that is printed and mailed. Moreover, if the employees would need corrections on their W-2s, due to mistakes, re-issuing these forms electronically would just take only two days instead of two weeks as is case with manual transactions.

**Source:** Federal Computer Week, Dibya Sarkar "State makes payroll info self-service" March 31, 2003

### **Challenges in the current ecosystem**

- Technical skills
- Long cycle of approvals
- Data duplication
- Scalability
- High on CAPEX as well as OPEX

### **Challenges in the current ecosystem**

Several countries around the world are attempting to revitalize their public administration and make it more efficient / service oriented.

To accomplish this transformation, governments have been introducing innovations in their use of technology for service delivery to citizens. While eGovernance has proven benefits, the traditional architecture lacks an integrated approach. This restricts knowledge sharing and ease of implementation across government institutions.

Some of the key challenges with the traditional IT infrastructure employed within the government include:

- **Technical skills:**  
Although IT promises to improve learning, the knowledge and skills base within local governments as well as citizens, is too low to make optimum use of the same. Many eGovernment projects have been impacted adversely due to the lack of right skill sets.
- **The lack of institutional mechanisms to drive and sustain eGovernment initiatives further complicates the matters for Government decision makers.** For instance many states in India don't even have an IT department or just have a skeletal department that is not designed to deal with the innovative application of technologies.
- **Long cycle of approvals:**  
Most government initiatives have long approval cycles that involve a tedious process consisting of multiple levels of submission / approvals. As a result, there are delays in the timely implementation and adoption of new IT initiatives.
- **Data duplication:**  
Departments within the governments lack uniformity in platform and software due to non-standardization, which causes each department to maintain their own data. As the traditional infrastructure does not permit the transfer of data between departments, information is not shared, which could result in duplication.
- **Scalability:**  
Many core systems deployed by various state and local government agencies need immediate upgrades. The legacy systems used by some of the most important departments and agencies in state and local government - including, finance, HR and health departments are not able to meet their growing needs. Moreover, the costs associated with the maintenance of these systems are significant. Also, the traditional IT environment cannot be easily scaled up or down to meet changing demands for IT resources.
- **High on CAPEX as well as OPEX:**  
Hardware requirements such as servers, firewalls, switches for governments are quite substantial, leading to surmounted capital expenditures. At the same time, the costs for maintaining this infrastructure, along with the need for uninterrupted power supply and cooling solutions are very high.

## The Cloud in government

The next level of change in IT in government could be the Cloud. The flexibility provided by the Cloud infrastructure can be leveraged by the government to deliver services through the eGovernance model.

Even though the pace of usage of the Cloud in the government is slow, the government is expected to play a lead role in adopting the Cloud. The benefits of having information systems hosted on the Cloud and flexible service models cannot be overlooked by the Government CIOs.

The Cloud leads to flexible resource allocation since it allows the IT department to easily respond to changing demands of the user community. As Cloud offering can bring new services and scale up/ revamp computing capacity, IT administrators can better manage risks and events such as peak demand. The Cloud architectures can benefit governments by helping to reduce duplicate efforts and increase effective utilization of resources. Besides enabling flexibility, the Cloud approach also provides other benefits:

- **Implementation of eGovernance:**  
Since governments require massive IT infrastructure, the Cloud is just apt for them to use as it helps drive eGovernance by making things more transparent and helps to bridge the digital divide by simplifying access.

### Case Example 03 - Adoption of the Cloud by the US Federal Government

In September 2009, the US Federal Government's Cloud Initiative was announced, GSA (General Services Administration) serving as a provisioning hub for Government Cloud. By 2014, over USD 1 billion of the federal IT budget would be devoted to the Cloud. By moving to a cloud service, GSA now pays an annual total of USD 650,000 for USA.gov and all associated costs, a cost savings of nearly 72 percent.

The migration to the Cloud could save Washington D.C. city government 48 percent on mail expenditures and the City of Los Angeles 23.6 percent

**Source:** World Bank

- **Cost optimization:**

As workloads get allocated flexibly and dynamically to any available computer system, the governments would see much higher system utilization levels. Further, integrated and collocated IT infrastructure could bring in significant cost savings.

- **Information sharing and leveraging common platforms within governments:**

Efficiency levels are likely to increase through greater sharing of data within and among governments. With the adoption of the Cloud, data duplication is expected to reduce as government agencies will be able to access the shared data. They would therefore only need to factor in the effort needed to record additional information.

The Cloud would also enable the modernization of public administration that would help public officers work more closely on citizens' requests and save on the effort invested in administration.

Moreover, governments in developing countries, through the adoption of the Cloud, could leapfrog transformation goals as it allows them to leverage common platforms across multiple agencies, reduce the TCO of infrastructure, save taxpayers' money; and improve citizen access to services and information.

Therefore, though the business cases and technical benefits for moving into the Cloud are the same for the government as they are for the private sector - potential savings are much larger.

Using Cloud services and delivery models would not only bring about a transformation within the government but also significantly improve interactions among the government and other stakeholders.

### Case Example 04 - Taiwan announces the Cloud initiative

Taiwan's government recently announced plans to invest USD 744 million to develop cloud computing technology and services over the next five years. According to an August 2010 IEEE Spectrum article, a cabinet level advisory task force has now been formed to help government agencies choose which Cloud computing projects to fund.

The government is building its own private cloud in order to combine the information systems in over 4000 government agencies into two or three cloud computing centers. The project is expected to create 50,000 jobs.

**Source:** Gcn.com; Article taiwan-launches-cloud-initiative

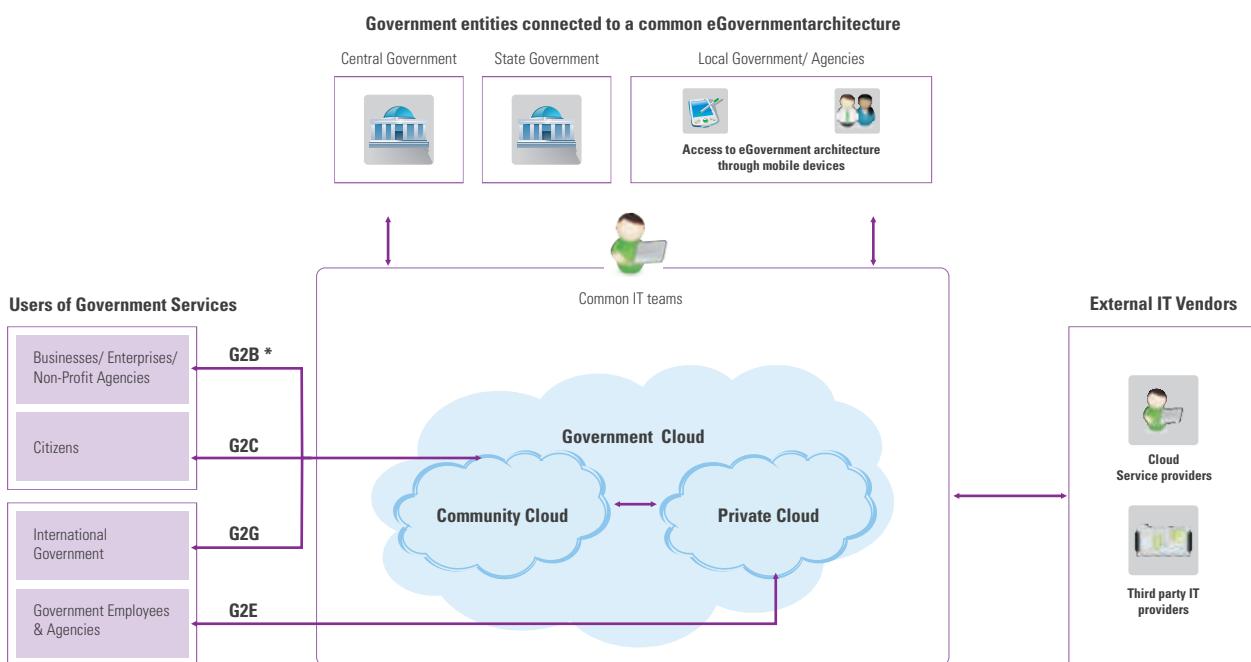
## Delivering value through the Cloud for the government

Governments sometimes experience spikes in user demand. Therefore they need to account for infrastructure that can handle these spikes. This however increases the need for high performance and capacity IT infrastructure.

Cloud services could help manage peak demand by enabling On-Demand resource provisioning which can be scaled up or down as per needs, without impacting the TCO. In today's connected world, government workers need to be able to move seamlessly from the browser to the computer to a mobile device for flexible, yet unified, experiences.

Government ecosystem with the Cloud

Figure 03



\* Businesses, Citizens and International Govts. can access the relevant information through the Community Cloud

Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

Central, State and local governments and associated agencies can use the Cloud to deliver better services, even as they work with fewer resources. This would enable the government to achieve savings through economies of scale and standardization. Consequently, the adoption of the Cloud would also create a good impression on the citizens as taxpayers' funds will be used judiciously while promoting the use of environmentally-friendly IT solutions.

## The government Cloud – Current implementations by governments across the world

The US government was dealing with several inefficiencies with their IT architecture. According to sources, even though the average server utilization within the Government was only approximately 7 percent, state governments needed more investments in IT to meet with the demand<sup>2</sup>. E.g., it would take the US General Services Administration (GSA)<sup>3</sup>, the procurement arm of the US government, an average of six months to make any changes that were required on the Federal government's ([www.USA.gov](http://www.USA.gov)) website.

2. Datacenterknowledge.com; 'kundra-fed-data-centers-7-percent-utilized'  
3. Refer to glossary

Today, the US government is taking steps towards implementing a 'Cloud-first' policy. By adopting the Cloud business model, the Federal government plans to consolidate data centers through virtualization. The Federal government site [www.apps.gov](http://www.apps.gov), also provides a shopping cart for US government agencies to purchase applications from a catalogue of over 3,000 Cloud-based applications<sup>4</sup>. The GSA is moving its email service to the Cloud, which is provided externally through the use of a private Cloud.

The government of United Kingdom is also not far behind in deploying a Cloud adoption strategy. The nation has undertaken a government wide Cloud strategy. The British government's G-Cloud has a hybrid Cloud structure with a public-private architecture catering to multiple communities. The British government is also building a Government Application Store, which is expected to not only be an application store but also the only channel for IT services procurement in the British government<sup>5</sup>.

### Cloud adoption in the Indian government

The Indian government organization has numerous central, state and local agencies. Many of these agencies refer to the same data. However due to the 'silo' nature of the Indian government all this data is housed under varied formats and if it is electronically stored, the information is not shared. Consolidation of this data even if it is initially done at a state level would bring huge benefits and efficiencies with minimized duplication. The Cloud could also reduce the effort of converting data to multiple languages, which today is one of the barriers to data sharing between various government agencies in India.

In the Indian context, standardization needs to be introduced in order to smoothly access the data. This would speed up delivery of eGovernance services to the people. Instead of making massive IT investments in procuring IT hardware and software by different branches of the government, India could directly leapfrog into the Cloud. Moreover as the Cloud has the ability to scale up to serve simultaneous transactions, citizens can look forward to fewer bottlenecks.

#### Case Example 05 - Implementation of eGovernance in India

The computer-aided Administration of Registration Department (CARD) is one such success story of eGovernment in the Indian state of Andhra Pradesh. About 214 registration offices had been completely computerized since April 1998. Land deeds could be registered in one hour and other services like the issue of encumbrance certificates and valuation certificates were issued in 15 minutes. Within two years of operation, 700,000 documents had been registered under CARD.

In the past, citizens used middlemen (who used corrupt ways of getting things done) due to the opaqueness of property valuation system. Time-consuming manual copying and indexing of documents and storage in paper forms were totally replaced.

**Source:** [adb.org](http://adb.org)

As the telecom industry progresses and mobile phones are used as an affordable, accessible and portable device for accessing eGovernance services, the future involves effective and user-friendly integration of mobile devices with Cloud-based services. mGovernance, with a push from the rise of the Cloud, can be transformative for governance.

While Indian policy-makers believe that the Cloud could be used to hasten the delivery of eGovernance, there are a few Cloud adoption challenges that would need to be addressed.

4. Futuregov.asia; Article on 'Government-cloud-public-or-private'

5. Ukauthority.com, Government-wide IT strategy to be launched in December, 26 November 2009

#### **Case Example 06 - India's Unique Identification (UID) application on the Cloud**

According to Unique Identification Authority of India (UIDAI), the UID application will be architected for the cloud and will sit on an 'eGovernance Cloud platform,' that will be assembled using open architecture and components. Providing UID application overview and requirements, the authority observes that Cloud computing is fast emerging as the next generation computing paradigm to build and deploy Internet applications targeting large sets of geographically dispersed users.

Further, the utility of Cloud computing is in that it facilitates these applications to be deployed and managed in distributed systems across data centers and provide clean abstraction for low level resource and application management. Typically these deployments are highly virtualized and help businesses use processors, memory, disks and network in an optimal way.

**Source:** [deccanherald.com Article 'unique-id-sit-egovernance-cloud'](http://deccanherald.com/Article/unique-id-sit-egovernance-cloud)

#### **Cloud adoption challenges for the government**

- Lack of control over the government's IT assets
- Security and data privacy
- Business continuity and disaster recovery
- Procurement and budgeting of IT

#### **Cloud adoption challenges for the government**

While it is expected that the Cloud could ultimately transform IT in the government there are also some concerns that must be looked at.

- Lack of control over the government's IT assets:
- The biggest obstacle to adoption of the Cloud by any public agency is the lack of control over IT assets and data. There is a fundamental shift in moving from a traditional IT environment to the Cloud. Enterprises are moving away from a model where they control all aspects of solution delivery to a model. A large portion of the control associated with the applications deployment and run-time characteristics of a service is being done by the Cloud service provider. This is a significant move for the government which traditionally keep its IT systems close and its data even closer.

#### **Case Example 07 - Hong Kong and the Philippines hesitant to host sensitive data on the Cloud**

Chiu Sai-ming, Chief Assessor at Hong Kong's Inland Revenue Department, believes that though it is vital to take advantage of new technologies, he would not house taxpayer data outside of his ministry. He is voicing his concerns over the security of using the Cloud services to manage tax payer information.

Ray Roxas-Chua, Chairman of the CICT for the Government of the Philippines believes that the 'inherent risks' of the Cloud need to be addressed before government embraces it as a viable way of managing information.

**Source:** [Futuregov.asia 'hong-kongs-tax-office-casts-doubt-over-cloud'](http://futuregov.asia/hong-kongs-tax-office-casts-doubt-over-cloud)

- **Security and data privacy:**

Governments should be concerned about their sensitive data being located to data centers outside of their own country. Moreover, there could be concerns around partnering with multinationals, especially for the government, as there is an element of uncertainty in the way the data is handled. Governments in Europe and other parts of the world are concerned that the Cloud is a US-based development that may compel them to adopt online practices that they did not anticipate.

Data privacy is a concern especially in the public sector, as it needs to conform to various privacy norms such as the FISMA and Privacy Act of the US<sup>6</sup>.

6. Center for Development of Advanced Computing, Article "Cloud Computing – Challenges and Opportunities" February 2010

Moreover, a service provider residing outside of a government's legal or territorial jurisdiction may put access or security at risk.

Today there is still a reluctance to shift core, mission-critical data storage or applications to the public Cloud, even if the cost savings and efficiency arguments are significant. This is because of concerns about the reliability and security of the Cloud offering. The security debate is perhaps even more intense when it comes to the public sector.

- **Business continuity and disaster recovery:**

Data residing on servers in the government's own premises provides a sense of security, especially from the point of view of control and recovery in case of any disaster. In the Cloud this concern multiplies, as there are no standards defined as yet in terms of recovery of data. Thus, business continuity and data recovery are considerable challenges faced by the Government in the adoption of Cloud services.

- **Procurement and budgeting for IT:**

Budgeting for technology spend within the government is done much in advance. Therefore, the pay-per-use and On-Demand features of the Cloud would make it difficult for the governments to decide the budget required for these services as the demand would be somewhat uncertain.

Moreover, the contracting and procurement processes are typically lengthy and tedious as the government tries to negotiate fewer long-term contracts that fit the needs of all the agencies involved. Because they are long-term contracts, they are easily outpaced by the technology innovation cycle, which would mean that the government may not optimize their investments.

## Futuristic view

In the future governments would own fewer and fewer of IT assets, its focus on IT would be more about the management of information and not really about seeing through the mechanics of IT systems. Over time government CIOs would become Chief Strategy Officers (CSO), as focus shifts away from technology, and the trend moves to less hands-on technology and more governance.

The mobile evolution with the advent of 4G is also expected to transform the government and services provided by them. eGovernment specialists say mobile devices are the next frontier for public outreach. Smart phones, tablets, netbooks, and other handheld devices will transform the way government services and transactions are performed. The Cloud could provide a common platform for adoption and scalability.

The Cloud could bring a seemingly utopian dream of transparent efficient governance to reality. It would be especially beneficial to countries such as India that experience delays and inefficiencies in many government procedures. The success of the delivery of government schemes and services to citizens especially in the rural areas could be easily tracked and monitored. The use of technologies such as eSignatures, would also help verify the authenticity of the documents, and ensure delivery of government services. This would also marginalize the role of the middlemen in the ecosystem. At the same time, the seamless exchange of files and information between different government agencies through the Cloud would enable the auto-implementation of the 'Right To Information Act'.

Even though the government sector has recently begun using the Cloud, it is expected to significantly transform its functioning. As governments, the world over, begin to realize the true potential of a ubiquitous Cloud environment, the Cloud is expected to be adopted at an even greater pace.

## Cloud for healthcare

### Introduction

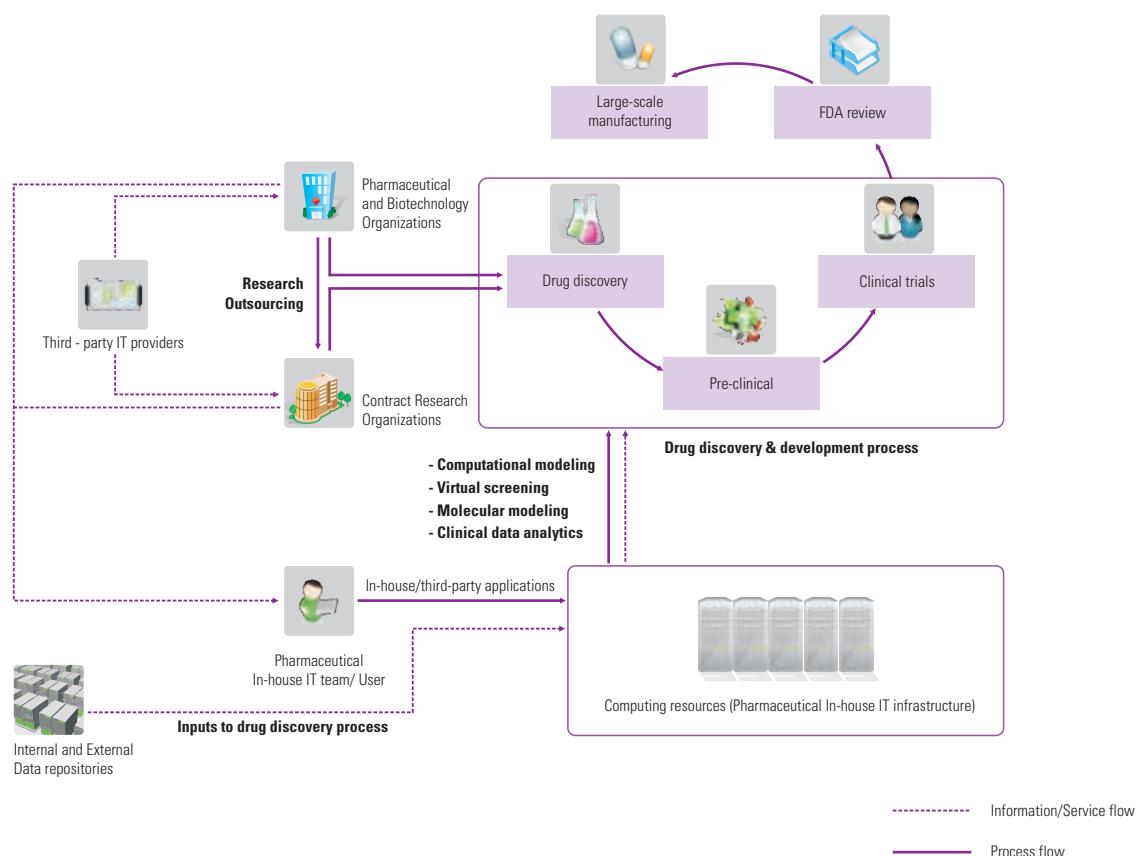
A typical healthcare ecosystem consists of the providers namely doctors, physicians, specialists (those who work out of hospitals, clinics, nursing homes, etc.), payers (health insurance companies), pharmaceutical companies, IT solutions and services firms, and the patients.

In the context of technology usage or information management, the healthcare ecosystem handles two key processes viz. the drug manufacturing process and the healthcare provisioning process. Both these processes manage massive information loads and as such rely heavily on computing resources.

A simplistic view of these processes in the ecosystem is represented in figures 1 and 2.

The pharmaceutical ecosystem

Figure 01



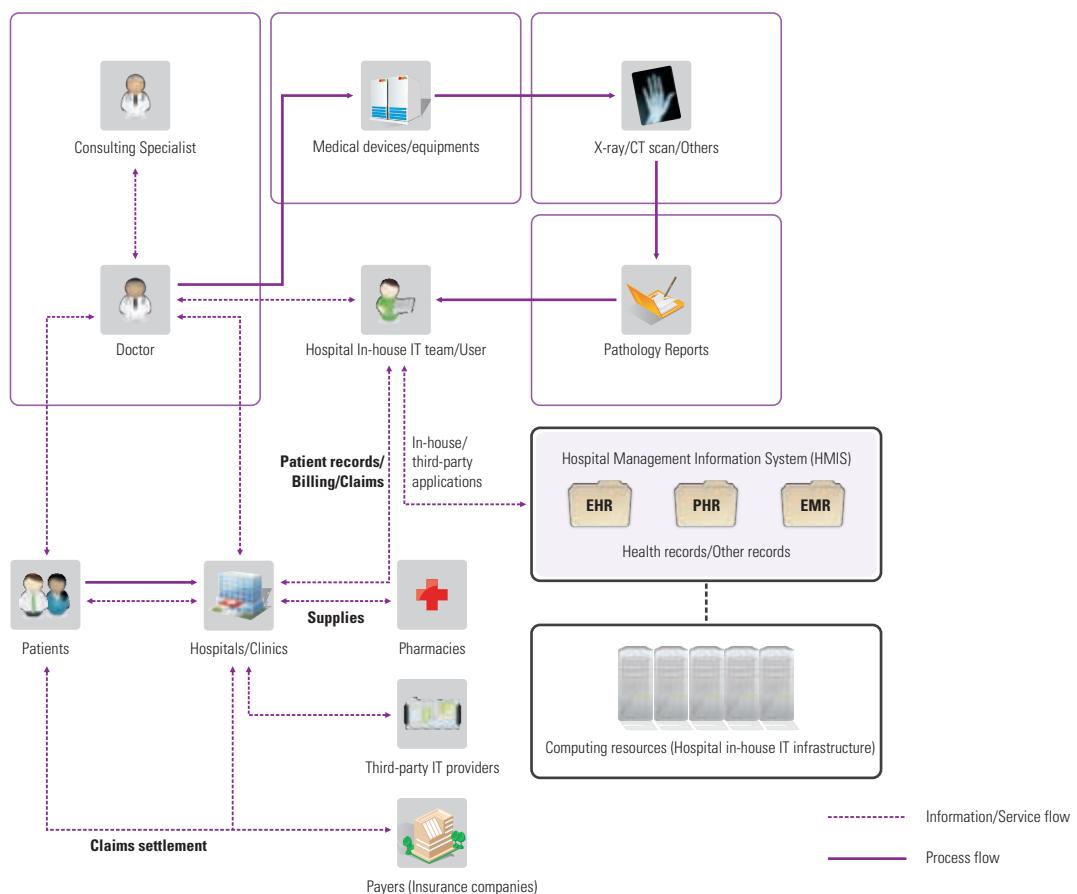
Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

Typically, a pharmaceutical company either runs its own research, for drug discovery and development, with the aid of its in-house IT infrastructure or outsources it to a contract research and manufacturing organization that supports its research process. On an average, a drug takes about 12 - 15 years from discovery to the approved medication stage and requires an investment of about USD 1 billion<sup>1</sup>. Out of more than a million screened molecules only one is investigated in the final stage clinical trials and is finally manufactured commercially after approval. Of the total investment, a few million are spent on acquiring, utilizing and maintaining computing resources.

1. Boehringer-ingelheim.com; Drug\_Discovery\_Process<sup>1</sup>

The healthcare ecosystem<sup>2</sup>

Figure 02



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

In the healthcare provisioning process, once the patient is admitted into the hospital and his details are entered in the Hospital Management Information System (HMIS)<sup>3</sup> (retained within the hospital premises or within a data center in its network) the process of diagnosis begins.

The doctor is now involved in understanding the matter or illness and the resulting reports that are generated are maintained in the HMIS. In the process, the doctor might take expert advice as and when required either in person or remotely through telecommunications or video conferencing services. Third-party hardware and software solution providers are generally given the task of managing the systems within the hospital network.

An increasing number of patients coupled with a high number of follow up visits results in the generation of large amounts of information. Thus, it is necessary for IT software and systems to be periodically upgraded and overhauled. Hospitals need to spend a significant portion of their budgets on non-core resource costs, both manual and technical in the traditional healthcare ecosystem. This in turn increases the cost of healthcare for patients.

### A booming healthcare industry

With the rising costs of provisioning healthcare services to patients, the healthcare industry has turned into one of the largest industries globally with the public and private spending estimated at around USD 5 trillion in FY 2010<sup>4</sup>.

2. Refer to glossary

3. Refer to glossary

4. Healthcarecompetitiveness.com

Almost half of this market is within the US, which continues to be the largest spender on healthcare services. Globally, healthcare services' spending continues to grow rapidly and represents a sizable sector in world economy (approximately 7 percent of global GDP in 2010)<sup>5</sup>.

The global rise in health expenditure is driven by:

- A strong economic growth in the world's emerging countries, demanding better healthcare facilities
- Population ageing, technological change, growing consumer awareness and expectations.

This growth also indicates the rising healthcare provisioning cost which remains unabated and a critical issue in the industry, forcing it to re-evaluate its operational efficiency and effectiveness.

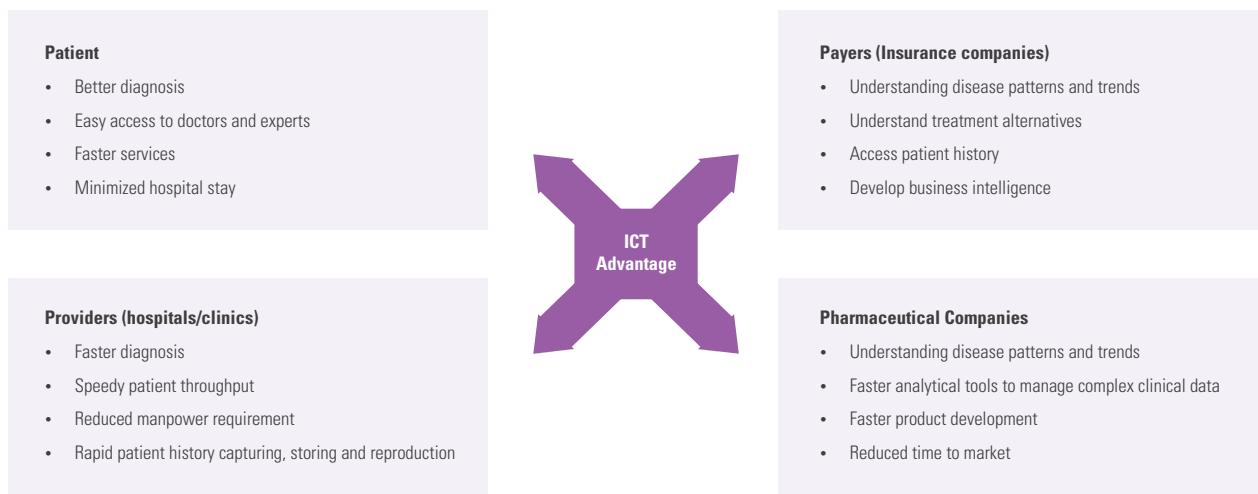
### The current role of technology in healthcare

The healthcare industry has been leveraging technological innovations for decades to provide superior quality services to patients. Medical technology-based devices and equipments such as Computed Tomography (CT) Scanners, Diagnostic Sonographic Scanners, Magnetic Resonance Imaging (MRI) Scanners, remote monitoring<sup>6</sup> devices, health and wellness-check devices, etc. have helped in diagnosing health problems without the need for expensive and hazardous surgeries. Most countries invest significantly in medical technologies and this market is growing rapidly.

Information and Communication Technology (ICT) has performed a major role in digitizing and communicating patient information, leading to rapid patient diagnosis which further leads to faster time-to-treatment and superior overall health services. Stakeholders in the healthcare industry have benefited by ICT applications in terms of efficiency and quality.

### Benefits of ICT to key healthcare industry stakeholders

Figure 03



**Source:** CIOL.com, KPMG's The Cloud: Changing the Business Ecosystem, 2011

Communicating digitized patient information is typically done through a system like 'Telecare'<sup>7</sup>. Volumes of patient data are transformed into information for decision-support through HIT applications and systems that are crucial for providing successful telecare services. Typically, healthcare providers make use of systems like Hospital Management Information System (HMIS), Picture Archiving and Communication Systems (PACS)<sup>8</sup>, Electronic Medical / Health Records (EMR<sup>9</sup>/EHR<sup>10</sup>) system or Personal Healthcare Records (PHR)<sup>11</sup> system to facilitate clinical workflows in order to provide telecare services.

5. Healthcarecompetitiveness.com  
6. Refer to glossary  
7. Refer to glossary  
8. Refer to glossary

9. Refer to glossary  
10. Refer to glossary  
11. Refer to glossary

In developed countries such systems are used in a collaborative manner across the nation, improving the effectiveness of such systems. However, large scale adoption is still a challenge. In developing nations such systems are being used in the private sector mostly in urban localities and are virtually absent in rural regions.

All these systems have one common thread viz. digitization of data. The digitization of clinical data, particularly in the form of EMR / EHR or PHR, and the automation of back office operations, form the basis of an efficient patient care system.

#### **Challenges in the traditional healthcare ecosystem**

- Ageing population driving the need for advanced, cost-effective technology
- Inadequate government spending
- Shift in disease burden from acute to chronic diseases challenging the limits of the traditional IT environment
- Workforce shortages and migration of skilled labor affecting specialist availability
- Changing regulatory framework forcing digitization of health records to handle information efficiently

#### **Challenges in the traditional healthcare ecosystem**

In the context of the two key processes that exist in the healthcare ecosystem, all the information generated is managed within the pharmaceutical company or the hospital. As such, it becomes mandatory for them to put a robust network of IT systems in place. Maintaining such a robust network of systems in-house increases the overall operational costs. The current ecosystem faces several challenges that demand technological advancement for sustaining itself in the future.

- Ageing population driving the need for advanced, cost-effective technology:

The global population is ageing. According to the World Health Organization (WHO), the global population of those who are 60 years and older will rise from 600 million in 2002 to 2 billion by 2050<sup>12</sup>.

Patient care for the elderly is necessitating advanced technologies and expensive healthcare services. This is increasing patient care provisioning costs for healthcare service providers. With the generation of large amounts of health data or information, huge IT storage infrastructure and back-up solutions would be required.

The use of technologies such as mobile phones, PDAs, laptops, iPads, etc. to reach out to patients in remote locations may not be a cost-effective solution. The back-end technology infrastructure needed to provide such services is expensive to source and maintain

- Inadequate government spending

Government spending on healthcare has been largely inadequate in developing countries. This has led to the poor development of the public healthcare infrastructure. As appropriate funding is unavailable, governments and healthcare providers need to focus on sourcing / developing and deploying cost effective solutions that include technologies that could aid in providing healthcare to the masses.

- Shift in the disease burden from acute to chronic diseases challenging the limits of the traditional IT environment

There is a significant shift in the disease burden from acute to chronic diseases in developing countries. According to a World Bank report, the incidence rate of cancer, diabetes, obesity and heart disease in developing countries are nearing those of developed nations, and these chronic diseases would be the leading cause of death in developing countries by 2015<sup>13</sup>. With the spread of the disease burden globally, there is expected to be an increasing need of resources, both human and material, to address this need. This is likely to further add to the additional information management infrastructure requirement that can raise healthcare provisioning costs.

Deploying advanced technology efficiently and cost effectively would be essential to address the growing demand for healthcare facilities in the remotest of areas. Innovation in the technology deployment is critical to meet this demand.

12. Who.int

13. KPMG Issues Monitor; ' Sharing Knowledge on the Healthcare Sector',

- **Workforce shortages and migration of skilled labor affecting specialist availability**  
Healthcare providers in developing countries are also struggling to maintain a well-trained and committed workforce. There is a huge mismatch in terms of the disease burden and resources required to handle them in these countries. Moreover, lower salaries, lack of better career prospects for healthcare professionals in developing countries is driving brain drain and creating a demand-supply gap. As this gap widens, accessing superior medical expertise would become expensive, further increasing healthcare costs.

- **Changing regulatory framework forcing digitization of health records to handle information efficiently**

At the core of Healthcare Information Technology (HIT) applications is the management of patient records. Digitization of these or converting them to Electronic Health Records (EHRs) offers several important benefits<sup>14</sup> to all stakeholders. Realizing the potential of cost containment by deploying EHRs, several countries have slowly started implementing HIT policies, making EHRs mandatory.

Among the various geographies, Europe currently is a leader in health IT and EHR adoption followed by Asia-Pacific and the Americas. Countries like Australia, Canada, Denmark, the UK, New Zealand, the Netherlands and more recently the US have implemented EHRs, where the governments have mandated its adoption. In Canada there is a public-private partnership in the implementation of HIT and EHRs<sup>15</sup>.

#### **Case Example 01 - US Hospitals adopt EHR to qualify for incentive payments**

Obama Healthcare IT Stimulus Incentives will begin in early 2011. In order for all hospitals to qualify for incentive payments of USD 2 million dollars per facility and USD 44,000 per physician's clinic, they must demonstrate 'meaningful use' of an ONC Certified Complete EHR for 90 continuous days prior to payment commencement in May 2011.

**Source:** prlog.org

Though the startup costs are high, EHRs can provide long-term solutions in delivering cost-efficient healthcare services for developed nations. In developing countries like India, there is no particular law or regulation mandating adoption of EHRs and the healthcare industry is unorganized to a large extent with minimum collaboration. In such cases, large-scale adoption of HIT and EHRs may not be a feasible option. Rather, they could first focus on localized usage of EHRs within their own network of hospitals and try improving other areas such as procurement, supply chain management and resource management.

## **Introducing the Cloud in healthcare**

The healthcare industry is evolving while grappling with several socio-economic and technological challenges along with the need to drive down HIT costs. A solution to this problem could be sought by moving to the Cloud.

Managing massive clinical data or EHRs requires heavy capital expenditure for sourcing and maintaining the IT infrastructure needed to store, transfer, retrieve, modify or print data and reports. At a state or a national level this could mean the storage and management of thousands of terabytes<sup>16</sup> of data. All of this can be done more efficiently and at minimum costs if the data is moved into the Cloud.

The Cloud is a paradigm shift in HIT which enables stakeholders to focus more on their core competencies. In the case of the healthcare industry, it would involve the provisioning of healthcare products and services to patients by physicians, clinics, pharmacies, public health organizations, and payers. Providing a range of services across the entire spectrum of care would require the ability to scale application workloads, collaborate and share information and at the same time ensure that patient information is authentic and secured, and available anytime, anywhere. It would also mean the changing of business models, automating processes, streamlining workflows, and consolidating IT assets.

14. Healthit.hhs.gov

15. KPMG Issues Monitor; Sharing Knowledge on the Healthcare Sector

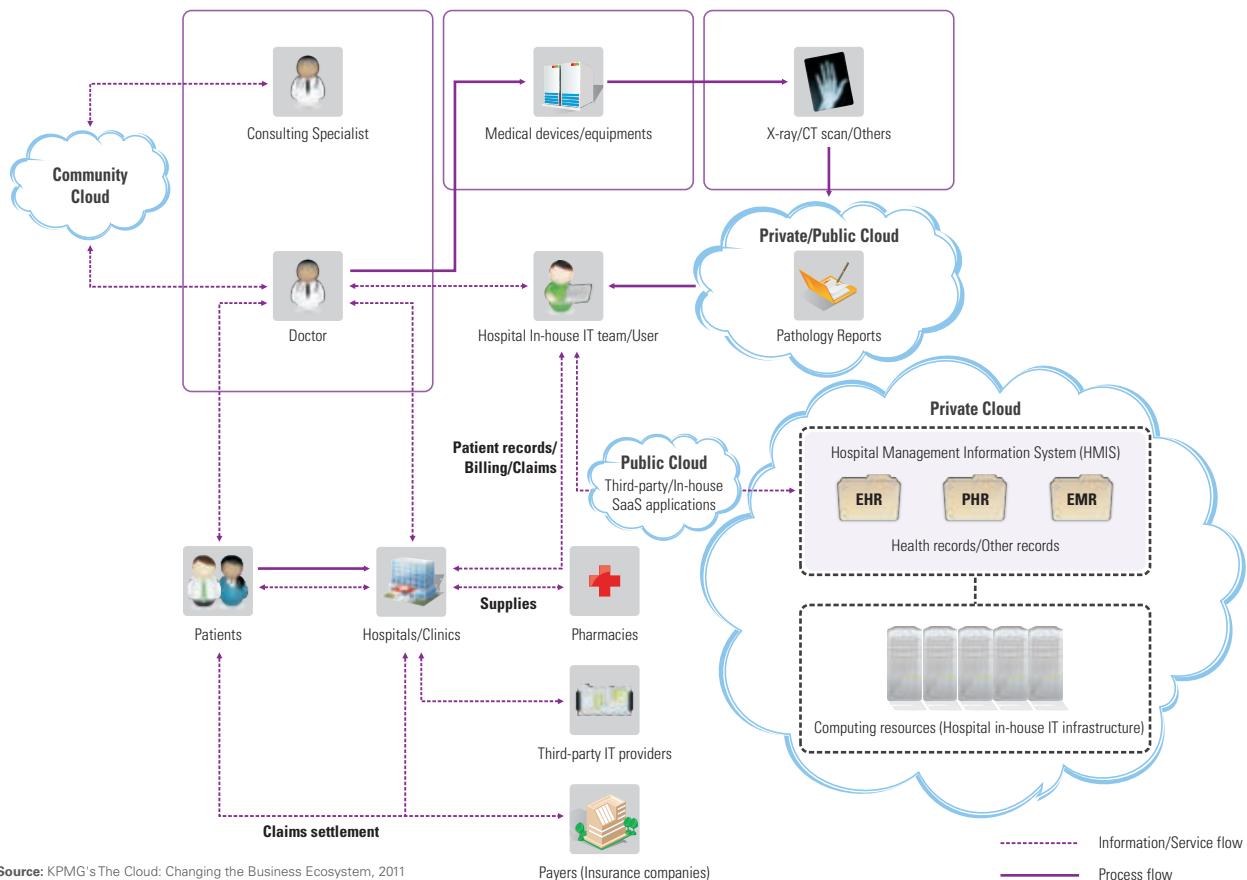
16. Refer to glossary

### The evolving healthcare ecosystem

The Cloud is an IT deployment model that today's HIT departments could consider an investment towards developing a fully optimized health record and service management system.

Paradigm shift in healthcare ecosystem – The Cloud

Figure 04



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

Doctors or physicians could use medical appliances in their clinics to capture patient information and transfer it through a web-based SaaS application hosted in the Cloud (public or private) managed by the Cloud service provider. Applications would encrypt and de-duplicate patient information prior to transmitting the same into the Cloud. Patients and doctors could access the records securely by exchanging secure electronic keys or third-party security devices similar to the way secure credit card transactions occur over the internet.

#### Case Example 02 - Bangalore eye hospital experiments with e-healthcare software

In 2009, an eye hospital in Bangalore started piloting software that sends retinal images collected from patients in remote locations to doctors' iPhones. Doctors can then quickly get back with their diagnoses and recommendations from the iPhone.

Going a step further, using SaaS application with a pay-as-you-go model via the Cloud can help in sending real-time images instantly from anywhere using handheld devices without having to host the software in the hospital.

Source: PCworld.com; KPMG's The Cloud: Changing the Business Ecosystem, 2011

In a private Cloud scenario, hospitals could transmit and store data in a secure fashion between their affiliated physicians or other member hospitals through Single Sign On (SSO) access mechanism for easy and rapid access to information. In this way, hospitals can reduce their IT infrastructure burden and overall management cost.

In a public Cloud scenario, outpatient diagnostic centers can share results through the public cloud in a similar fashion like the private Cloud. Delivering services via SaaS applications in a public Cloud is also prevalent in physician offices. Similarly, drug manufacturers can make use of computing resources via cloud and reduce costs drastically<sup>17</sup> using IaaS model. Every stakeholder in the healthcare ecosystem stands to benefit from the Cloud.

#### **Key benefits of the Cloud to healthcare industry stakeholders**

- Pharmaceuticals/Drug manufacturers- Drug manufacturing utilizes heavy IT infrastructure for its Research and Development (R&D) needs. The IaaS model could provide a drug manufacturer with On-Demand computing resources to perform drug research analysis, eliminating the need to retain computing capabilities and related IT expertise in-house.
- Hospitals- Using in-house or third party SaaS applications that are housed in the Cloud, patients can provide access to their health history and information so that hospitals can streamline the admissions, care and discharge processes. Hospitals can connect to their own web portals and access patient data stored in the Cloud.
- Physicians- With the Cloud, people can provide their health history and information to their physicians anywhere, anytime, including data uploaded from health and fitness devices, to help physicians make more informed decisions.
- Pharmacies- People can administer or manage their prescriptions and associated information such as dosage, amount and frequency, and provide this information to their healthcare provider.
- Laboratories and imaging centers- Patient's diagnostic results can be transferred via suitable Apps onto Cloud-based platforms, e.g. Google Health or Microsoft HealthVault. This eliminates the need for in-house storage and helps retain historic information in a systematic manner. Healthcare providers can access these results with the patient's permission, to help them make more informed health decisions.
- Application Providers- Health and wellness companies can design and deliver health and wellness solutions compatible with Cloud platforms to offer rich user experiences and ease of managing users' sensitive personal health information.
- Device manufacturers- Health and fitness devices can be designed to work with Cloud platforms and Apps, so users can upload device data and share it with their doctors and families.
- Payers- Health payers can offer their members with innovative tools compatible with their chosen cloud platform to provide value added services by giving members' access to more health information, and thereby increasing the effectiveness of their care management programs which can help reduce claims costs. Payers can enable plan members to add health data to their records in the Cloud and provide it to their healthcare providers.

In case of the adoption of the Cloud, the responsibility of managing the underlying IT infrastructure to provide the aforementioned benefits lies with the Cloud services provider.

#### **Delivering value through the healthcare Cloud**

The Cloud has already started delivering value to the healthcare industry. Radiology departments are amongst some of the early adopters. They are exploiting the massive computing capability made available through the Cloud<sup>18</sup>. Hospitals and laboratories are being charged per image for their storage requirements. The stored images are not restricted within geographic boundaries. They are accessible from anywhere and anytime to the clinicians or physicians to make informed decisions.

17. Explained in the section 'Cloud a boon for pharmaceuticals and drug manufacturers'

18. Mis-asia.com; 'Cloud-computing-in-healthcare-it'

For hospitals, besides keeping the costs low, the Cloud model also helps to easily meet regulatory compliance requirements of maintaining EHRs. The adoption of the Cloud would not only benefit the payers but also the pharmaceutical companies.

Smaller hospital set-ups and physician practices usually do not have the necessary IT staff required to support and manage new technologies or mission-critical applications. Non-core IT Apps can be handled through Cloud-based SaaS applications with minimal expert manpower and the hospital can only pay for what they use.

In the case of hospital-chains there is a need to share information within the network. The Cloud can provide a cost effective solution to such hospitals through the establishment of a centralized EHR service hosted on the Cloud. Rather than using the traditional license-based software, hospital chains could take the advantage of the elastic pricing models, scalability, and flexibility offered by the Cloud. This would mean that as demand increases or decreases, healthcare providers don't need to make significant investments in scaling their IT infrastructures up and down..

The Cloud can also help reduce the overall Total Cost of Ownership (TCO) for healthcare service providers, which could go down between 10 to 30 percent according to certain estimates<sup>19</sup>.

### **The Cloud a boon for pharmaceutical companies and drug manufacturers**

The pharmaceutical industry is going through a major transition. Eighteen of the top 20 branded drugs are expected to lose their patents in the next 4 to 5 years<sup>20</sup>. This could mean huge revenue losses for these companies driving them to cut costs and increase pressure on their R&D budgets. Traditionally, pharmaceutical companies have relied on their own R&D divisions to identify and deliver the next blockbuster drug. However, research<sup>20</sup> indicates that industry spending on R&D more than doubled since 1999 while the average number of new drugs approved by the Food and Drug Administration (FDA)<sup>21</sup> each year has declined. Beefing up R&D budgets is not the only solution, therefore pharmaceutical companies are outsourcing their R&D requirements to smaller biotech firms. These firms have lesser funding to run large scale research and grow their businesses. The challenge that remains is how to perform high-end large scale research and increase client portfolio at a much lower cost. The Cloud could be used as solution to this, both for large drug manufacturers as well as for small contract research organizations.

#### **Case Example 03 - Eli Lilly adopts Amazon Cloud**

According to Eli Lilly's CIO, Michael Heim, the company is using Amazon Web Services (AWS) to provide high-performance computing On-Demand to hundreds of its research scientists<sup>1</sup>. According to Dave Powers, the firm's associate information consultant for discovery IT, the Lilly was able to launch a 64-machine cluster computer working on bioinformatics sequence information, complete the work, and shut it down in 20 minutes using Amazon's Elastic Compute Cloud (EC2) service. It cost USD 6.40. According to Dave to do that internally is a 12-week process<sup>2</sup>. The company is also exploring ways to expand the use of the Cloud beyond short-term research projects and sees the Cloud as central to its future IT strategy.

**Source:** Datacenterknowledge.com; Wellsphere.com

The pharmaceutical industry has several characteristics that make it quite suitable for the Cloud. Drug manufacturers require enormous, varying and scalable computing resources throughout the different phases of the product lifecycle, for the complex informatics that go into scientific and drug development research. The industry has been using high-performance grid computing to support their R&D work. However, the provisioning of computing resources internally is always faced with delays. In a business where competition is cut-throat and time-to-market is the most crucial success factor, even a day's delay in the R&D process could cost millions of dollars for a breakthrough drug.

19. Expresspharmaonline.com

20. Stitoday.com

21. Refer to glossary

Cloud-based IaaS solution could provide On-Demand access to technology for a life-sciences company in an effective way compared to the traditional technology deployment that could take significant time to increase computing capacity. Similarly, through the use of a Cloud-based SaaS CRM solution, a pharmaceutical company would not need to implement an On-Premise CRM system, while gaining the benefits of a pay-as-you-go service. Such a facility is beneficial for small as well as large biotech and pharmaceutical companies.

Several pharmaceutical companies are seeing the Cloud as a key solution for their concerns:

- **Peak scale-out:**

At times pharmaceutical companies need massive computing power of a train of servers for just a few hours to run high performance computing (HPC) models of complex genetic sequencing, molecular modeling and chemical processes. The Cloud's On-Demand computing with a pay-as-you-use model suits such short project requirements or spikes. The Cloud is being used as an extension of the existing internal infrastructure.

- **Scalability of applications:**

Cloud services are highly scalable and as such can be used to reduce processing time significantly and expedite the R&D processes. The time taken to conduct a typical modeling experiment could be reduced by several hours in comparison to the time taken by in-house applications.

#### **Case Example 04 - Pfizer uses Cloud to run bioinformatics models**

Giles Day, senior director of informatics at Pfizer's Biotherapeutics and Bioinnovation Center (BBC) says that cloud has transformed the way they do a lot of their work. Pfizer ran their Rosetta macromolecular modeling in the cloud to determine antibody-antigen docking, using about 500 EC2 instances. This reduced a typical experiment of 48 hours to about 3.5 hours. Day explained that Rosetta modeling is done in EC2 and all results are stored in S3 (Simple Storage Service); the results are then scored, ranked and filtered in EC2, and returned to S3. Because bandwidth between EC2 and S3 is free, bringing the compute to the data saves the company significant money.

**Source:** [Bio-itworld.com](http://www.bio-itworld.com)

- **Collaboration tools:**

The Cloud can also provide a flexible and cost-effective platform for collaborating between multiple parties. Drug manufacturers are experimenting with the sharing of algorithms for analytics and securely exchanging data with collaborators across geographies.

As they gain more experience, pharmaceutical companies could look at exploiting the Cloud even further. They could expect a greater number of high end computing resources, convenient workload movement between internal environments and the Cloud, improved security measures and more efficient procurement in-line with business objectives.

#### **Is the use of private Cloud a preferred model for the industry?**

The healthcare industry has already started exploring the Cloud and deriving value from it. However, this model raises certain concerns related to data security, data integrity, and availability. The decision to utilize a public, private, hybrid or community Cloud therefore differs from user to user. Current trends indicate that the private Cloud is a preferred model for the industry.

Considering the nature of the business involves the management of highly sensitive patient data; most healthcare providers are exploring private Cloud. Until, the concept of the Cloud gathers adequate acceptance across industries, pharmaceutical companies are expected to primarily resort to the comforts of the environment of a private Cloud. Healthcare providers like hospitals and physicians who are used to using third-party software would be most comfortable with SaaS applications and IaaS.

Healthcare technology coupled with the power of the Cloud could be effectively used to handle industry challenges. This is due to unique characteristics of the Cloud like rapid provisioning, elasticity, On-Demand self-service, resource pooling, broad network access and metered service.

## Cloud adoption challenges for the industry

Though the Cloud in healthcare provides several benefits for all the stakeholders of the industry, it has its own set of challenges. Some of these include security, privacy protection, disaster recovery, regulatory, governance, and the reliability of the Cloud.

- **Patient information security and privacy protection**

The primary reason the healthcare sector would offer resistance to making a move to the Cloud would be patient information security and privacy protection. Patient information across countries has been under the purview of legal frameworks e.g. the data privacy requirements legislated through HIPAA<sup>22</sup> (Health Insurance Portability and Accountability Act) privacy rules in the US. HIPAA provide federal protection for personal health information. Similarly, the European Union has several directives pertaining to data protection. In many countries, the patient's Protected Health Information<sup>23</sup> (PHI) cannot be moved out of the country of origin. Finally, the patients themselves would be concerned about the security of their personal data.

The Cloud for healthcare would need to have a very strong data protection and privacy system in place to gain large scale acceptance / adoption in the marketplace. Therefore, the public Cloud environment may not be suitable for many healthcare applications. The Cloud's vulnerability to security breaches is similar to any traditional infrastructure environment. The adverse impact is, to a large extent, due to sensitivity of the information involved. A preferred solution to tackle the issue would be the use of a private Cloud coupled with secure access protocols and systems. Several Cloud service providers have come up with data and privacy protection equipments and tools; however, the industry is still skeptical of their effectiveness.

- **Interoperability and standardization**

The Cloud offers the ability to shift all data / information onto systems and storage platforms provided / managed by Cloud service providers. At times, it may so happen that health records of a patient stored, in the Cloud by his personal physician, might be needed to be accessed by the hospital that the patient was referred to. In such cases, the hospital should be able to access a patient's health records stored on a different Cloud. At the same time, it is also expected that there would be a large number of software and applications that would exist in a Cloud. In order to ensure efficiency and optimum utilization of resources, it would be ideal if there is a high degree of interoperability and standardization between healthcare solutions for the Cloud.

Unifying the Cloud is an ideal state, but quite a distant goal to achieve, considering that there are several standards existing today. At the same time, there are also a number of Cloud standardization groups:

- Distributed Management Task Force (DMTF)<sup>24</sup>
- Cloud Computing Interoperability Forum (CCIF)<sup>25</sup>
- Open Grid Forum's 'Open Cloud Computing Interface Working Group' who is developing standards for managing the cloud.

Almost all industry majors like AMD, Broadcom, CA Technologies, Cisco, Citrix, Dell, EMC, Fujitsu, HP, Hitachi Limited, IBM, Intel, Microsoft, Novell, Oracle, Rackspace, Red Hat, and VMware are members<sup>26</sup> of such groups and could accept one or the other standard. But it would be difficult to convince everyone in the business to accept a single interoperable / standardized system.

22. Refer to glossary  
23. Refer to glossary  
24. Refer to glossary

25. Refer to glossary  
26. <http://www.dmtf.org/about/list>

## Cloud adoption- the Indian healthcare scenario

Contrary to what is happening in some of the leading economies of the world, the Indian healthcare industry is at an extremely nascent stage of adopting the Cloud. Currently, the Indian healthcare industry is evaluating and experimenting with technology deployment models including the digitization of health records like EMRs and remote patient monitoring.

Seventy percent<sup>27</sup> of the Indian population lives in rural India and most of them lack access to hospitals, physicians, trained medical personnel, critical medicine supply and medical equipments. India has only an elementary network of public hospitals and clinics (around 25,000 primary health centers<sup>27</sup>). Public hospitals are also scarce outside large cities, and their service standards vary.

Most healthcare services in India are provided by the private sector, mainly through independent practitioners<sup>28</sup>. Top private hospital chains are very bullish on the Indian market due to factors such as

- Rising income levels of the burgeoning middle-class
- Increased lifestyle diseases such as heart disease, cancer and diabetes
- India's emergence as a leading destination for medical tourism

### **Case Example 05 - Heavy investments in private healthcare sector**

- In October 2010 Wockhardt announced that it would spend around USD 150 million building three new hospitals that would double its number of hospital beds to 2,000 by 2013.
- Apollo, which is the biggest private hospital group in Asia, planned in August 2010 to add another 3,000 beds to its existing number of 8,500 beds by 2014, at a cost of USD 500 million.

**Source:** EIU.com

Private players are therefore investing heavily into healthcare infrastructure.

The national healthcare spending in 2010 was estimated to be at USD 78.6 billion, or 5 percent of India's GDP<sup>28</sup> and the healthcare industry is estimated to have spent around USD 250 million<sup>29</sup> on its IT requirements in the same period. Most of these investments are in the private sector.

Meanwhile, research estimates put the addressable market for the Cloud in the Indian healthcare segment to reach around USD 600 million by 2020<sup>30</sup>. The current adoption of newer technologies in both the public and private healthcare sector is a precursor to this opportunity.

### **Case Example 06 - Increased traction in HIT adoption by Indian government**

- Delhi Municipal Corporation (DMC), in association with Wipro had implemented Hospital Information System (HIS) in the six hospitals managed by it, starting 2005.
- Tamil Nadu Government has allotted INR 5 crore to Tata Consultancy Services (TCS) to digitize all patient records in state-run hospitals. The system will start functioning in all the 26 district headquarters hospitals, 162 taluka hospitals and 77 non-taluka hospitals and some of the Primary Health Centres (PHCs) managed by the Government.
- In 2007, the Government of Maharashtra initiated an eight year, INR 180 crore networking and automation project to transform its public hospitals, including 19 key Government hospitals and 14 associated medical colleges across the state.

**Source:** Expresshealthcare.in ; Ehealthonline.org

27. Technologyreview.in

28. Eiu.com

29. Expresscomputeronline.com

30. Newkerala.com

There has been growth in total automation. Smaller hospitals are using the basic modules of HMIS such as health records, registration, scheduling, monitoring, billing, inventory management, etc. Larger multi-specialty hospitals are using advanced modules of HMIS such as PACS, remote patient monitoring and service delivery and data analytics, among others. At the same time, state governments are realizing the potential of HIT and investing locally.

Several Indian healthcare majors are experimenting with building their own HIT platforms across the country and they could soon choose to have a centralized information base to lower costs. However, they have not yet shown high levels of interest in terms of moving their systems to the Cloud.

The Indian healthcare industry has traditionally been a cost-sensitive market for software vendors. Key issues for the healthcare industry, as far as HIT adoption is concerned are:

- ? Upfront IT investment costs
- Non-availability of trained manpower
- 24/7 accessibility issue of data
- Slower transition period from the legacy system to the new system and maintaining it.

#### **Case Example 07 - Max Healthcare India uses Cloud to increase reach**

Max Healthcare, a large hospital chain in India has moved its Health Information System (HIS) to a private Cloud. The idea was to make it easier to treat and follow up with patients from any of its locations across the country. At a later stage, the hospital plans to move applications that will help its doctors collaborate across various locations.

The 10-year old HIS is a database of all the patients treated by the hospital chain and has over 1 million records. Max Healthcare will also deploy its EHR system in the cloud and is based on the open source VistA (Veterans Health Information Systems and Technology Architecture). Other applications to go in the cloud subsequently are its archival and storage system for all patient images.

According to the hospital, the private cloud infrastructure will give the hospital chain the scalability, reliability and better utilization of its servers as it expands its network of hospitals next year. Max Healthcare is also using MPLS (Multi-Protocol Label Switching) with back-to-back redundancy from two service providers in the country.

**Source:** [Pcworld.com](#)

Therefore, IT budgets have typically remained low and the industry has been cautious to adopt HIT. Of the 1.1 million healthcare enterprises that India has around 60,000 are in small hospital category (less than 30 beds)<sup>31</sup>. Most of these hospitals have standalone PCs on which the administration and patient information is stored, serving just the operational purpose. Some bigger hospitals make use of in-house servers to manage HIT systems. Apart from very large hospital chains, most of them are still remote from the concepts of leveraging HIT for business intelligence and integration of systems. But most healthcare providers are now realizing that it would be detrimental to cut IT costs, as it could be the backbone of a healthcare service provider's network.

31. [Expresspharmaonline.com](#)

Issues related to the adoption of HIT can be effectively handled with the Cloud. The Indian healthcare industry is slowly gearing up to this transition. Digitizing patient records and moving them into the Cloud could be the first step towards Cloud adoption. To save upfront on IT investments, hospitals can also move the Hospital Management Information System (HMIS) to the private Cloud deployed through IaaS. Later on, they can look at hosting SaaS applications in the Cloud to access patient records and other information. For example, accessing a Cloud-based CRM application through a web interface.

A combination of the Cloud and telecare could be used to reach the remotest of places in rural India. The Cloud model would provide elastic and measured services to cut costs, while at the same time providing broad network access through the use of mobile phones, laptops, and PDAs. Telecare can help in reaching and unifying primary, secondary and tertiary care facilities. Apart from this, local governments and hospitals could create a nexus with corporate institutions and Non Governmental Organizations (NGOs) to provide medical care over distance through video conferencing solutions.

The use of the Cloud in the Indian healthcare industry will take some time to pick up in comparison to its global counterparts. However, with the continuous nationwide improvement in the underlying infrastructure with regards to electricity / broadband connectivity and the backing of the government the adoption of the Cloud in the Indian healthcare industry is only expected to grow.

### **The evolving rural healthcare ecosystem**

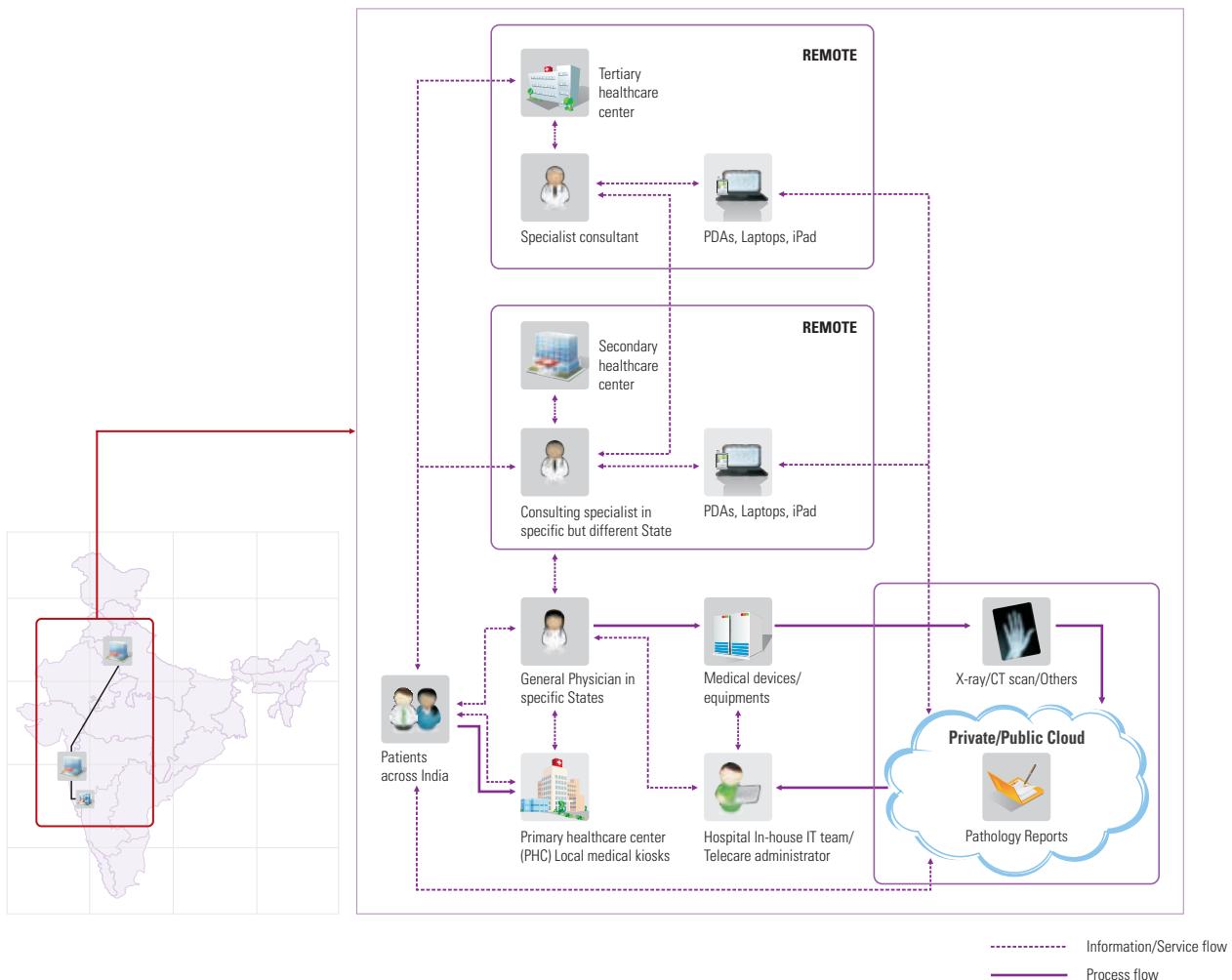
In developing countries like India there is an increasing dependence of the rural population on expensive private health services, as local PHCs have poor facilities. This often leads to indebtedness in rural areas<sup>32</sup>. To tackle this issue, hospitals can develop cheaper facilities like independent rural medical-kiosks or medical-kiosks within the PHCs that are telecare equipped. Assistance from the local government will be helpful in this case. In India, government bodies like the Departments of Science & Technology, Space (ISRO), Information & Technology and Health & Family Welfare have provided similar assistance to hospitals in the past<sup>32</sup>. Such a public-private partnership can ensure inexpensive, uniform, accessible, and equitable healthcare for the rural masses.

Additionally, the convergence of wireless technology and the Cloud could prove to be a very strong mechanism to cater to rural patient care. Most of the medical specialists tend to work in big cities and advanced care facilities are only available in larger cities, with the rural areas often lacking medical attention. This problem can be addressed effectively and efficiently through 'Tele-Cloud', a combination of telecare and the Cloud that will allow physicians and healthcare specialists to diagnose and treat patients over distances and beyond geographies seamlessly, in real-time, and cost-effectively. An example of how a Tele-Cloud can work is presented in the figure below.

32. Sgrh.com

Illustrative model of the Tele-Cloud

Figure 05



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

A typical Tele-Cloud system would operate as follows:

- A patient from a rural area visits the local PHC or medical kiosk for health consultation.
- The physician diagnosis the patient and uploads the pathology reports and patient records into The Cloud.
- Depending on the case, the physician recommends secondary or tertiary consultation.
- Patient history and medical reports are studied using the Cloud by the secondary or tertiary medical consultant (a medical expert) on his laptop, PDA or mobile phone at his location. A suitable Cloud-based SaaS application is accessed through an internet browser, which serves the purpose and the specialist is not required to be present.
- Expert advice is again communicated remotely through facilities like video-conferencing in the Cloud.
- The local doctor accesses any additional information or reports provided by medical experts through the Cloud during follow up care.

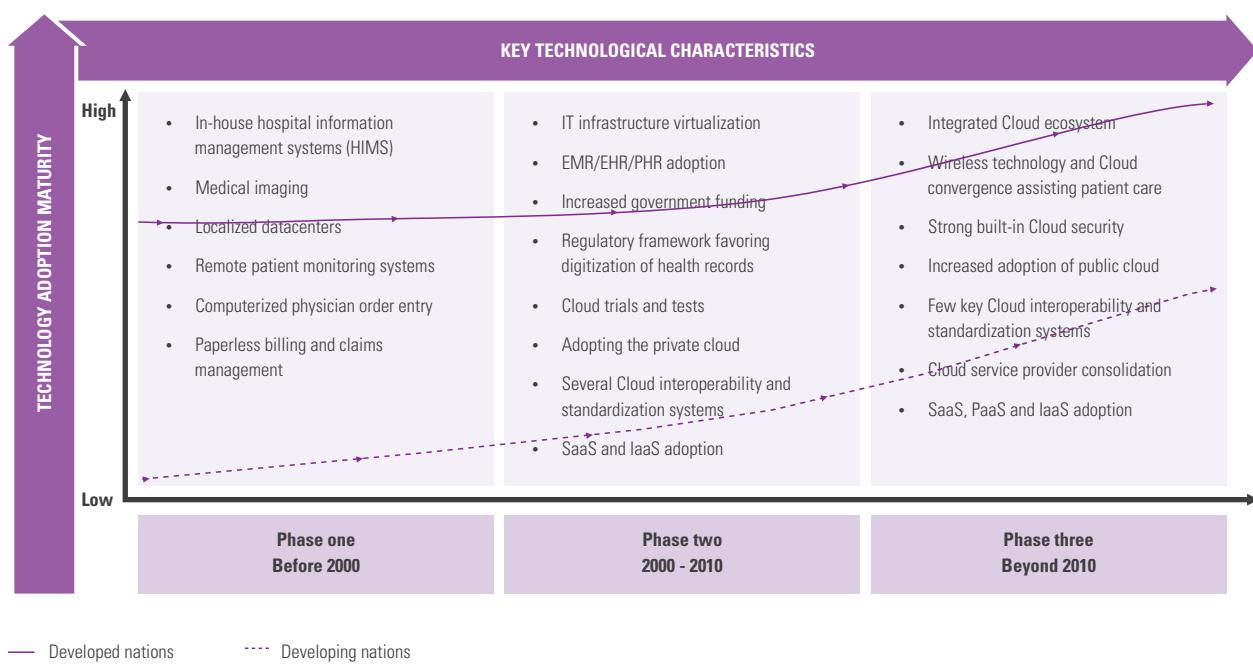
In this manner, convergence of the Cloud and wireless technologies could be useful in improving the quality of healthcare service being provided (at affordable rates) to the rural population.

## Futuristic view

The adoption of the healthcare Cloud is gradually evolving from the initial phase of implementing and using in-house IT systems to the private Cloud adoption phase. The Cloud is acting as a catalyst to offer a truly co-ordinated patient care system. In the future with an increasing number of people understanding the effectiveness and uses of the Cloud we could witness a more integrated healthcare Cloud ecosystem. However, the current marked difference in adoption between the developed and the developing countries will persist over the next decade. This gap can be reduced at a faster pace with the evolution of superior technology over the same period.

### Healthcare Cloud's journey towards an integrated Cloud ecosystem

Figure 06



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

Initially, the Cloud was being utilized for data storage and archiving which offered decreased cost and maintenance of physical hardware systems. With the progress in virtualization, along with reduced costs, the industry benefited from storage consolidation, streamlined IT resource management and accelerated application deployment. This opened up the scope for the use of broader Cloud offerings like SaaS, PaaS and IaaS services.

The Cloud has now shifted the industry's attention towards improving patient care at optimal costs through technological innovations including online appointment scheduling, computerized physician order entry, billing, and EHR systems. Globally, we will see a transformation in healthcare as new technology models emerge and the acceptance / deployment of the Cloud increases. The Cloud can eventually enable the creation of a globally integrated healthcare ecosystem. Consolidation in the Cloud service provider landscape and mature interoperability standards are likely to drive streamlining of Cloud services. Users can be able to rapidly access information anytime, anywhere. Cloud security tools and processes are likely to see further improvement and raise the comfort levels of the Cloud for the adopters. Increased collaboration within the stakeholders will further drive efficient deployment and utilization.

However, organizations need to determine which Cloud service models would balance their business objectives with risk exposure and costs. Choosing the right technology and Cloud service model while partnering with the right set of service providers would enable healthcare stakeholders to build a streamlined healthcare service platform in the future.

## Cloud for education

### Introduction

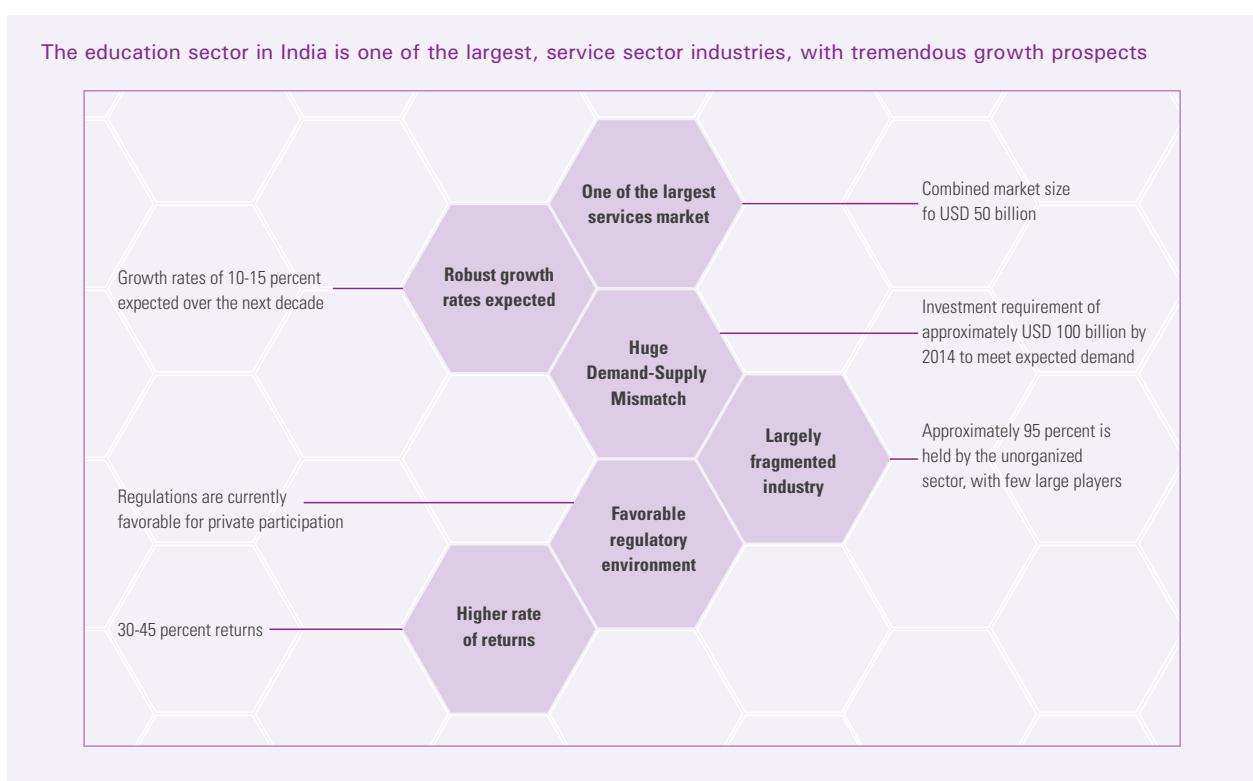
The education sector is one of the cornerstones of socio-economic development. It is widely accepted that education contributes to poverty reduction and increased economic growth, which in turn leads to an improved standard of living. It also enables the individual to participate in wealth generating activities, leads to the creation of employment, and the overall development of society.

Being one of the eight Millennium Development Goals (MDG)<sup>1</sup> adopted by member countries of the United Nations, they are putting a significant focus on the development of the education sector.

Like other sectors, the education sector has also felt the effects of the meltdown, with some countries reducing their budget for education. However, with the government making concentrated efforts to ensure that education remains a top priority, the sector is on an upswing. This is primarily because education is considered to be a linchpin in economic turnaround.

### Indian education sector

Figure 01



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

Both the Indian government and private players are investing in the education sector to leverage opportunities in the sector. While private players are primarily catering to the needs of the urban segment of the education sector, the government has taken several initiatives to upgrade the reach and quality of education in rural and semi-rural areas.

1. Refer to glossary

<b>The Indian government has taken several initiatives to promote education in India.</b>	
<b>Teachers Training</b>	<ul style="list-style-type: none"> <li>Restructuring teacher training programmes towards creating good quality teachers</li> <li>Constantly upgrading the capability of teachers through short and long term courses</li> <li>Expansion of research programmes/projects and creating incentives for growth in research facilities through publicly funded projects/research</li> </ul>
<b>Macro Considerations</b>	<ul style="list-style-type: none"> <li>Provide quality education in rural areas focusing on skill development by encompassing 10 million students every year and making them industry ready</li> <li>Plans on reducing the drop out rates to 20 percent and increase literacy rates to 85 percent</li> </ul>
<b>Budgetary Expansion</b>	<ul style="list-style-type: none"> <li>Increased the budget for expansion of higher education facilities to INR 850 billion from INR 96 billion allocated during 10th five year plan</li> <li>Setting up 30 central universities – including one in each of the 16 states so far covered</li> <li>Expanding and upgrading 200 State Technical Institutes, 8 IITs, 10 NITs and 20 IIITs</li> </ul>
<b>Admission Curriculum, Assessment</b>	<ul style="list-style-type: none"> <li>Create a common platform for admission through a common entrance test and/or other relevant criteria for professional courses under central universities</li> <li>Adopting of semester system across institutes</li> <li>Changing method of assessment from annual examination to internal evaluation</li> <li>Introduction of the Credit System making the system flexible for students</li> <li>Dynamic curriculum expected to change every three years with industry development</li> </ul>
<b>Accreditation and rating</b>	<ul style="list-style-type: none"> <li>Introduction of mandatory accreditation system for all education institutions</li> <li>Creation of multiple rating agencies with a body to rate these ratings</li> <li>Department-wise rating in addition to institutional rating</li> </ul>

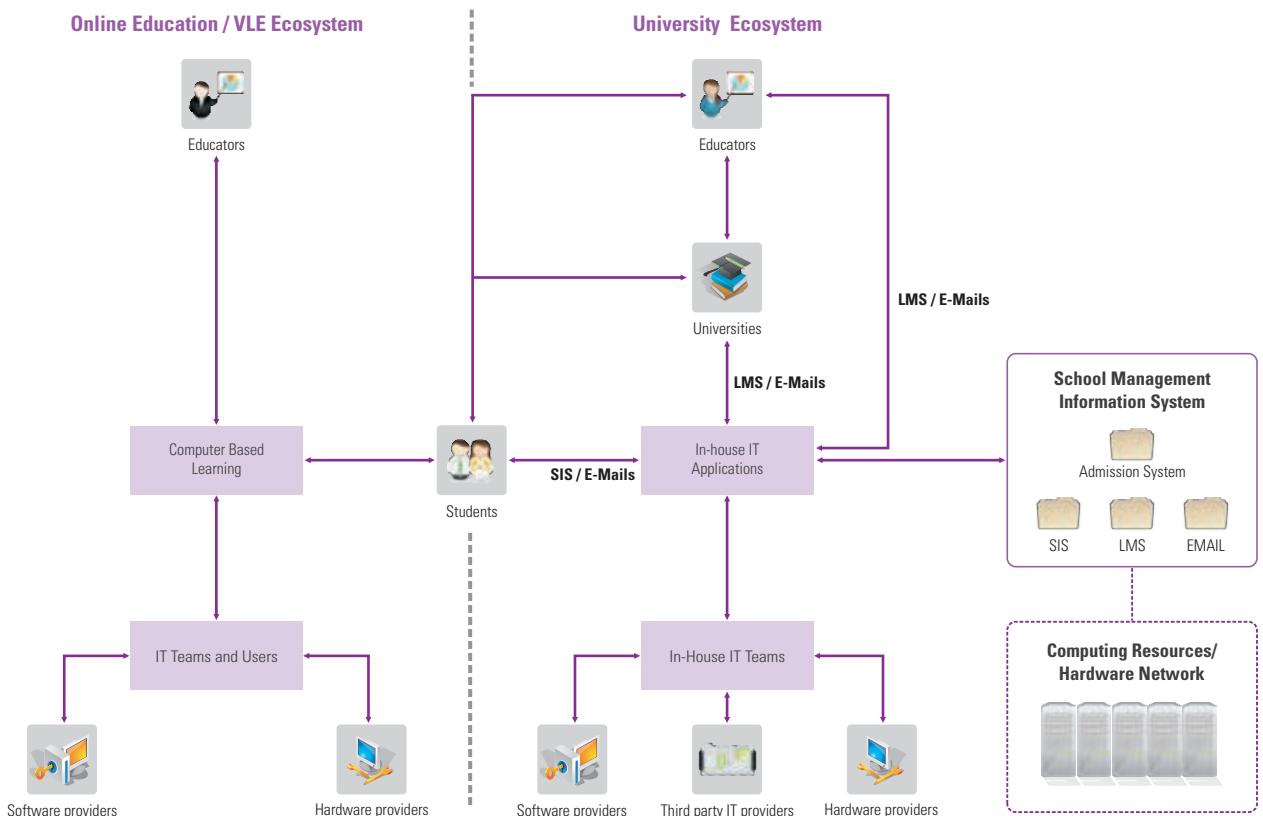
**Source:** KPMG's The Cloud: Changing the Business Ecosystem, 2011

However, as the sector struggles with rising demand and limited budgets, it becomes necessary to budget / manage in a lean and cost-efficient manner. The use of technology can not only help provide education in a lean and cost-efficient manner but also address concerns centered on quality of education.

Technology plays an integral role in today's educational ecosystem. It has become medium and facilitator of interaction between learners, educators and the school administration. Many schools have an in-house IT staff or third party vendors to provide support for their IT systems. An indicative view of the current ecosystem of the education sector in relation to the use of technology is shown in the diagram below:

## Education ecosystem

Figure 02



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

### Role of technology in the education ecosystem:

The education sector has historically shared a symbiotic relationship with technology. While on one hand, the sector has been a cradle for many technological innovations, on the other technology has played a pivotal role in the evolution of education and academia. IT has, in particular, played a catalytic role in making education a more collaborative and interactive process. Whether it is a fifth grade student taking science lessons through the use of a SMART<sup>2</sup> classroom suite in Asia or a management student learning corporate strategy through management simulation – aided with technology, education has taken a big step over the last 10 years.

2. Refer to glossary

In today's education system, students and educators are using technology in many areas like

- class room teaching
- online examinations
- online books and journals
- online forums for information.

Similarly, educational institutes are using technology for

- managing education content and scheduling
- recording student information
- communications
- managing the admission process.

Apart from the obvious use of technology in the organized segment of the education sector, technology has also penetrated into the unorganized segment. Training programs, private tuitions and vocational training programs are some of the services that are being provided through the use of technology in the unorganized segment.

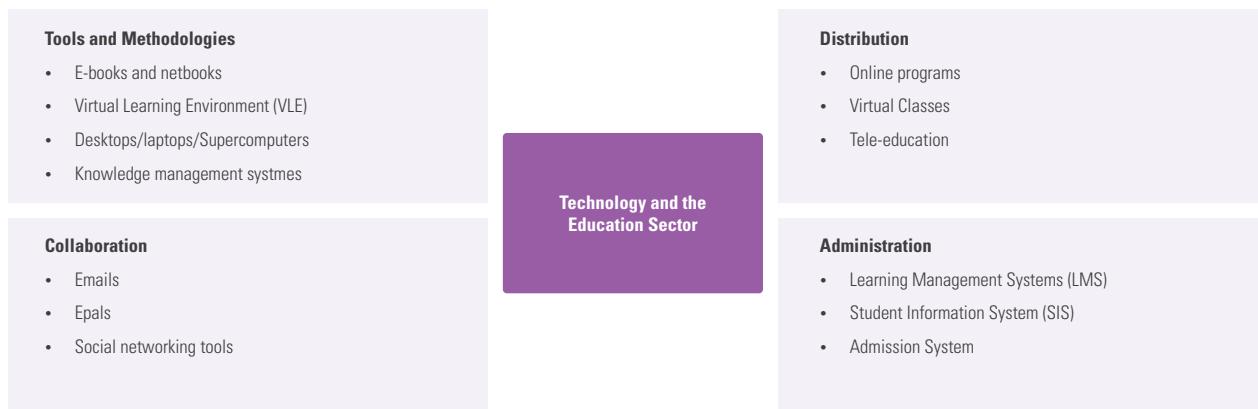
In the absence of regulations, this sector has had a non-uniform usage of technology. Some of the technology tools that are being / could be availed by this sector are

- Hosting programs
- Content management systems
- Interactive learning systems
- Automated enrollment processes

Technology, especially ICT has impacted several aspects of the education sector in the last decade:

### Impact of technology on various aspects of education

Figure 03



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

Some of the benefits of using technology in the education sector are given as below:

• **Standardized Tools:**

Traditionally, the tools like knowledge management systems, virtual learning environments, etc used by the education sector were proprietary in nature and limited to being used in select institutes or countries. Modern tools are more standardized, cheaper, and universal in nature

- **Environment of collaboration:**  
Globalization has highlighted the advantages of collaboration between people across geographies. Schools are increasingly in favor of using collaborative tools to prepare students for a future where common goals are achieved through interactions between people sitting across geographies
- **New modes for providing education:**  
Dependence on the brick-and-mortar infrastructure and traditional teaching methods was inhibiting the reach of education. New modes of providing education such as virtual learning environment, tele-schools and online education programs have enabled providers of education to cut across geographical boundaries. This has the potential to help governments boost literacy rates, especially in smaller cities and rural areas
- **Administrative efficiency:**  
New age education systems, regulations and guidelines of governing bodies require educational institutes to function as corporate firms do. Technology has provided management systems such as Learning Management System (LMS)<sup>3</sup> and Student Information System (SIS)<sup>4</sup> to enable better administration of schools and universities.

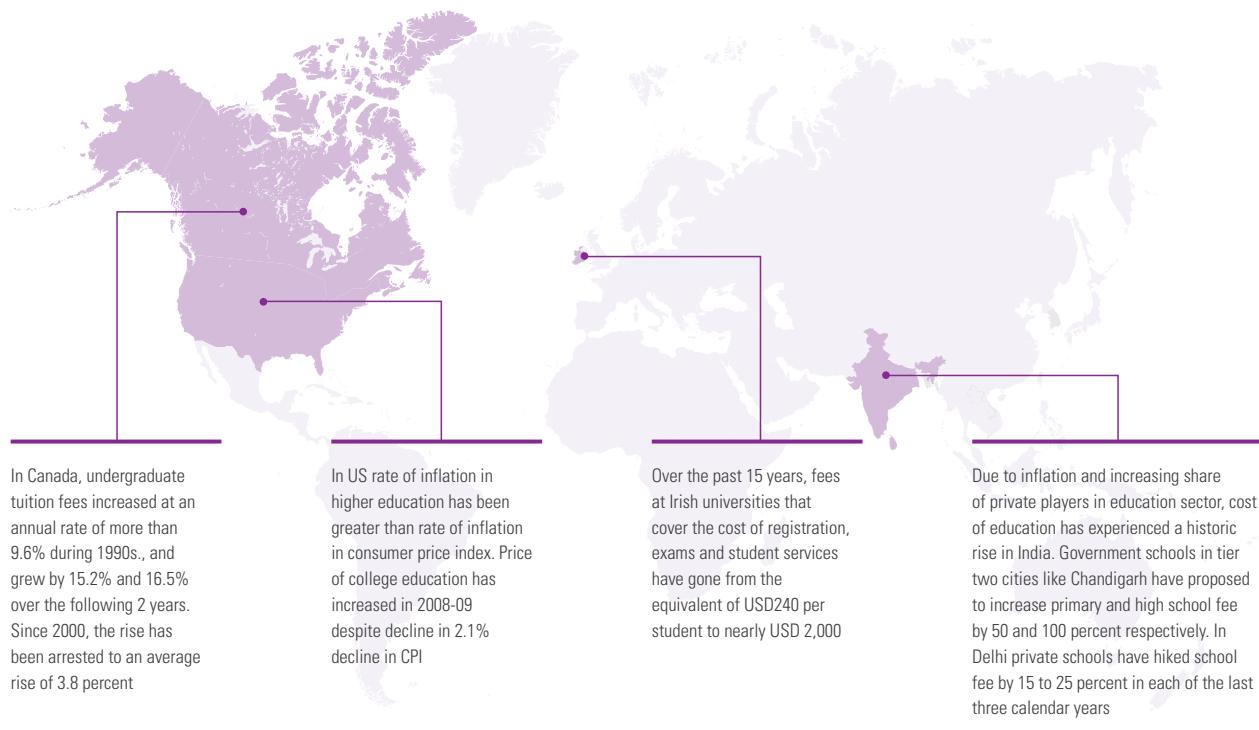
## Challenges in the present education ecosystem

### Socio-economic challenges

**Increasing cost of education:** One of the key issues confronting the sector is the rising cost of education across the globe.

### Impact of technology on various aspects of education

Figure 04



**Source:** KPMG Research, Nytimes.com, Canada Financials, Times.com, The Economic Times

Major reasons for increase in the cost of education are the labor intensive nature of delivering education sector and the increasing cost of technology.

3. Refer to glossary

4. Refer to glossary

**Cut down in education budgets due to recession:** The economic crisis has been most precarious for the education sector of developing nations. It had temporarily impacted not only its progress but also reversed the gains achieved over past years.

#### Case example 01 - Decline in education funding due to recession

Slower growth and declining revenue are jeopardizing public spending plans in education. For sub-Saharan Africa, the resources available for education could fall by USD 4.6 billion a year on an average in 2009 and 2010, or more than twice the current amount of aid to basic education in the region.

**Source:** UNICEF

**Limited reach of education:** With the efforts of international organizations such as UNICEF<sup>5</sup> and World Bank, there has been an improvement in the reach of education. However, as of 2008, 69 million primary school aged children had no access to education<sup>6</sup>. Today, there are 796 million people deprived of education globally, of which two-thirds are women<sup>7</sup>.

In developing nations, lack of infrastructure has been a major hindrance to the reach of education in rural and semi-rural areas. Infrastructure facilities such as buildings, power and telecommunications require significant investment from both public and private players. Developed nations, on the other hand, are struggling with high 'drop-out' rates due to the inflexible nature of the education system.

**Poor quality of education in developing nations:** Along with making education accessible to all, it is equally important to create conditions conducive to the development of skills. In many parts of the world, a significant gap exists between the number of students graduating from school and those among them who master a minimum set of cognitive skills. In India, over 600,000 villages and multiplying slum habitat, barely receive basic literacy instructions as "free and compulsory education" that is dispensed by barely qualified "para-teachers".<sup>8</sup> The poor quality of education and rudimentary physical infrastructure leads to high drop-out rate. Globally, an additional 1.9 million teachers would be needed in school to achieve universal primary education by 2015<sup>9</sup>. According to UNESCO, there are also worrying signs that improved access to schools has not been accompanied by enhanced education quality.

### Technology challenges

**High upfront cost of adoption of new technologies:** High upfront costs in the implementation and deployment of new technologies enabling a Virtual Learning Environment (VLE)<sup>10</sup> and online education have inhibited schools and universities from investing in them. These tools, in fact, are most needed in developing countries where the quality of education needs improvement. Moreover, regular maintenance and periodic upgrade of technology resources require these institutions to budget for an in-house IT department.

**Complexity in maintenance of technologies:** As technology evolves, the IT Infrastructure employed becomes increasingly complex and at the same time requires periodic upgrades and uninterrupted support. Therefore there is a need for dedicated in-house or third party IT teams. The complexity and cost of employing and maintaining IT departments and outsourcing services has been a major concern for schools. Rapidly changing technologies pressurize schools to switch to the most recent technology in order to take advantage of the benefits they offer. Moreover, apart from the huge capital investments that are required, managing changing technologies would be cumbersome.

5. Refer to glossary

6. According to preliminary estimates carried out by the UNESCO Institute for Statistics in March 2010)

7. UNESCO Annual report

8. Refer to glossary

9. Refer to glossary

**Underutilization of technology resources:** Present day technology needs resources – software and hardware - that can support peak load. Inconsistent usage patterns in smaller schools and programs like online education result in large expenditure on resources and the relative underutilization of resources. Deploying and maintaining present day technology for small groups is often cost prohibitive. Further, the overall infrastructure - reliable power supply, telecommunication, cooling systems, etc. - required for supporting these technologies are scarcely available in rural and semi-rural areas.

### The Cloud in education sector

The education sector has traditionally been cautious to embrace new technology due to factors such as cost and risk. But the 21st century presents new financial, demographic and industrial pressures to the education sector that are making it imperative for schools and universities to align themselves to the latest technology. In such a scenario, the Cloud could offer a highly acceptable solution to the education sector, helping it adopt evolving technologies without the burden of excessive cost and complexity.

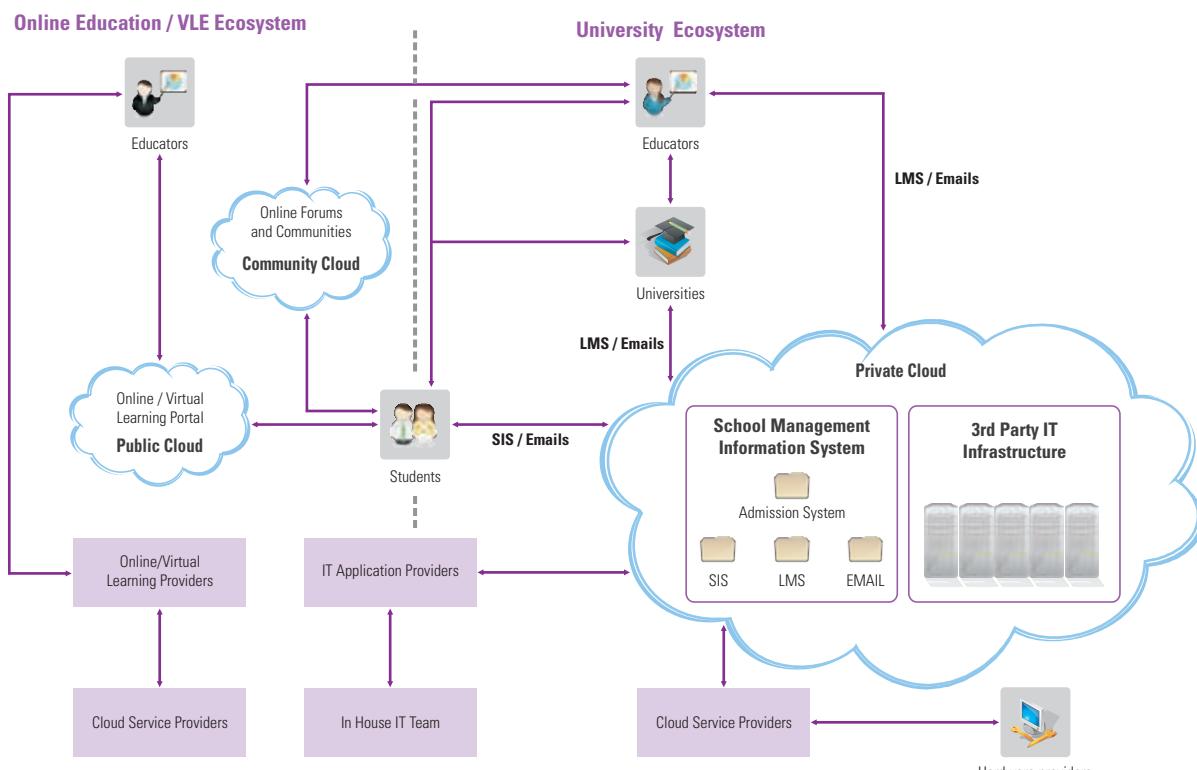
The Cloud has already started making its presence felt in the education sector, in India, as well as globally. Schools have started leveraging the Cloud for student e-Mails, collaboration tools and virtual desktops. The Cloud is also providing cost effective and low maintenance solutions to online programs and distance education programs. Affirmative feedback from the early adopters of the Cloud promises extensive use of this technology in the education sector.

Wider acceptance of the Cloud has the potential to make several alterations to ecosystem of education sector.

The following diagram presents a significant shift in ecosystem with the advent of the Cloud:

The education ecosystem after adoption of the Cloud

Figure 05



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

### **The Cloud offers an opportunity to reduce IT costs**

Increasing spends on technology and shrinking grants to the education sector are some of the key pain points of the education sector. Spend on technology is eating into a substantial part of a schools budget. One of the significant benefits of adopting the Cloud is the reduction in costs incurred on IT.

**The Cloud offers software, platforms and infrastructure at a much lower cost**

- The Cloud enables schools to avail of administrative software such as Learning Management Systems (LMS) and Student Information Systems (SIS) as service instead of paying hefty license fees for products. The SaaS model also helps schools reduce the capital costs of deploying software.
- The Cloud also offers IaaS to educational institutes. Research and Development departments of schools are now gravitating to the Cloud as the model has proven cost benefits – campuses do not need to maintain on-site IT infrastructure such as high-end data servers and application servers. It has also removed many restrictions prevalent on existing computer networks.
- The private Cloud for e.g. can also play an increasingly important role in teaching and learning. The school or university applications, documents, content, data, and services once plugged into the private Cloud can be accessed with just an internet connection and a web browser, from anywhere, inside the classroom or out, by the entire school community<sup>10</sup>.

#### **Case Example 02 - Reducing the managerial burden in school labs at North Carolina University**

Virtual Computing Lab is an example of a private cloud at North Carolina State University. The VCL (<http://vcl.ncsu.edu/>) has been in production for six years and serves 30,000-plus users and over 100,000 reservations per semester. Images that integrate software applications, operating systems, and other utility and network-based access tools are loaded on blades — high-end personal computers clustered in a centralized system. Upkeep of the automated blade clusters takes less than one-tenth of the lab personnel's time and effort that would be required to install and maintain hundreds of computing lab machines.

**Source:** vcl.edu

### **The Cloud offers to lighten management burden for schools:**

Increasing spends on technology and shrinking grants to the education sector are some of the key pain points of the education sector. Spend on technology is eating into a substantial part of a schools budget. One of the significant benefits of adopting the Cloud is reduction in cost incurred on IT.

- In the Cloud, the deployment and maintenance of software, and IT infrastructure would be the responsibility of the Cloud services provider. Hence, schools that use LMSs or SISs as SaaS need not worry about annual upgrades of software.
- Schools offering online distance education programs need to be concerned only about the content of the programs. Technical issues related to the hosting and maintenance of online portals would be the responsibility of the Cloud services provider.
- Schools that encourage research and development activities need dedicated IT teams for maintaining data centers and server farms. With The Cloud offering PaaS and IaaS, maintenance of IT infrastructure is taken up by the Cloud service providers.

10. Dell.com

### **Case Example 03 - The Cloud offers 'On-Demand' scalability to UC Berkeley**

In 2007, UC Berkeley began a pilot project class focused on developing and deploying SaaS. In 2008, the university moved the course from Berkeley-owned servers to the Cloud. According to Berkeley, they wanted undergraduates to gain exposure to the Cloud technologies as they believe they will be in demand. They also found the Cloud made it easier to fulfill assignments, such as saturating large database servers. Normally that assignment would have taken 200 local servers. Instead, they were able to acquire 200 servers in a few minutes, and they could release them once the lab was over.

**Source:** eschoolnews.com

### **Collaboration in education**

The Cloud offers solutions for cost effective and easy collaboration for researchers, students, teachers and parents. Schools have been trying to set up their own eMail systems, and there's been a big push towards using online platforms for learning and communicating with students and parents.

### **Case Example 04 - Institutes in Australia and New Zealand leverage the Cloud for e-Mail**

As per a Survey in 2010, seventy five percent of college and universities in Australia and New Zealand have moved their student e-Mail to the Cloud. In 2010, Macquarie University (Australia) moved its research, teaching and administrative staff e-mail to the Cloud.

**Source:** CAUDIT Member Survey

### **Case Example 05 - New York City DOE adopts a Cloud solution**

The New York City Department of Education (DOE)—the largest system of public schools in the United States, serving about 1.1 million students in more than 1,600 schools—chose ePals, a Cloud solution. ePals offers a cost-effective, secure, and private space where students easily could communicate and collaborate as part of their learning. The Cloud solution is expected to save the district from spending up to USD 5 million annually on infrastructure needed to host e-Mail for students, teachers, and parents.

City students also will be able to communicate with classrooms across the world as part of ePals' global community, which reaches 600,000 educators who teach 25 million students worldwide. This will enable parents to interact with teachers and school staff in almost any language. Parents will be able to receive e-Mail regarding school events and their children's progress in class.

**Source:** eschoolnews.com

### **e-books replacing textbooks thus reducing students' burden**

With textbooks getting dearer with time, education has become fairly expensive for students w.r.t the costs associated with buying textbooks. The contents of textbooks also require periodic revisions. With technology all the books can be put online and accessed through personal computers, tablets, laptops, cell phones, etc. Instead of buying a number of books over the entire course duration, students would be required to only invest in just one of these devices to access the Cloud.

### **Opening up research options**

One of the prominent features of technology is 'resource pooling', as it allows users to share common resources. This feature opens up new opportunities for research. The Cloud can support schools encouraging research and development by reducing the costs involved with computation, as most of the research requires capacity computing, with systems that share their computing power with several users.

Netherlands has been in the process of building a national IT infrastructure for science and research as a Cloud service.<sup>11</sup> This infrastructure includes a virtual laboratory for e-science with generic functionalities to support a wide class of specific e-science application environments. The technology and resources come from different sources such as SARA, BiG Grid, GigaPort3 and SURFnet, DAS-3, and Starplane. This could enable research domains such as high-energy physics, food informatics, medical diagnosing and imaging, biodiversity, and Dutch telescience<sup>12</sup>.

The Cloud allows research institutes to host research related data and collaborate with other research institutes. This feature would enable institutes that can't afford to collect or buy data for research purposes to avail for lesser cost. Research<sup>13</sup> has estimated that creating large scale datacenters is cost advantageous as the location enables commodity Cloud provider to operate with costs that are five to seven times lower than those of a mid-size data center<sup>14</sup>. Leveraging the same feature "Ensembl project" produces genome databases on the Amazon EC2 (an IaaS platform) for human as well as almost 50 other species, and makes this information freely available.<sup>15</sup>

### **Case Example 06 - Schools in California shift to digital textbooks**

Governor Arnold Schwarzenegger has called for California schools to shift to digital textbooks to save much of the USD 350 million that the state annually budgets for textbooks and instructional materials. Moreover, textbooks are hardly interactive and are isolated from the computing resources with which we have provisioned our schools at great expense.

**Source:** eschoolnews.com

## **Challenges of adopting the Cloud in the education sector**

Despite various advantages that the Cloud has to offer to the education sector, there are still challenges that need to be overcome to leverage its complete potential in education sector.

### **Privacy and risk of identity theft:**

These issues are raised by legal officers and senior administrators more than the end users – students, as they are not aware of issue of privacy. Educators and research communities are concerned about sensitive research data being stored beyond the bounds of their university. Further, high-end usage of the Cloud such as admission process and online assessment have issues related to validation, information, and identity theft.

### **Piracy:**

Another challenge of adoption of the Cloud by research institutes is the protection of intellectual property. Researchers and school administrations are hesitant to store confidential data on servers which are out of the university's boundaries. They are even more reluctant to store such information on shared facilities offered by the public Cloud.

- 11. Educause.edu
- 12. Gordon Cook, Building a National Knowledge Infrastructure: How Dutch Pragmatism Nurtures a 21st-century Economy, The Cook Report on Internet Protocol
- 13. Reliable Adaptive Distribution System Laboratory (RAD labs) at University of California, Berkeley,
- 14. Michael Armbrust, Above the clouds: A Berkeley View of Cloud Computing
- 15. Ensembl.org, 'Using the Ensembl datasets hosted on Amazon AWS'

### **Risk and nonperformance:**

Along with risk, strategies to deal with aspects such as unexpected service stalls from the Cloud need to be deployed. Another important aspect of risk associated with privacy and data, is to correctly classify and value the intellectual property of the data that is being moved to The Cloud, and then to build appropriate indemnity into the contractual arrangements. Doing so, not only ensures that Cloud service providers will correctly understand and value the data but also financially compensate the college or university in the event of a leak.

#### **Case Example 07 - Victoria University (Australia) initiates its move to the Cloud**

Victoria University is developing a strategy to re-architect its internal infrastructure so that integration with the Cloud can be done in a more seamless and elastic manner. In this environment, data and processing can move transparently between the university infrastructure and the Cloud provider. The university can then readily address and control performance issues by adjusting, in real time, how much of the service sits in the Cloud and how much stays on the university infrastructure.

**Source:** [educause.edu](http://educause.edu)

## **Future of education with Cloud technologies**

Though the education sector has historically been hesitant to embrace new technologies, it has been quick to begin the process of evaluation and adoption of the Cloud. The Cloud can prove to be catalyst to achieving some of the long desired social goals of the education sector such as "education for all" and "affordable education".

### **Meta-universities**

The concept of "meta university" may be realized sooner than envisaged across the globe. A meta-university is a conglomeration of several universities that give access to scholarly publications, scientific works in progress, tele-operation of experiments, and worldwide collaborations, thereby achieving economic efficiencies and raising the quality of education through a global endeavor. A meta-university would have a global network for high learning, focusing on collaborative learning and knowledge, while operating on web-based platform. The Cloud could prove to be an ideal platform that can support such a concept.

Collaborative learning could become the norm as the Cloud takes care of the technological challenges. Meta-universities could enable developing countries to contribute to the global intelligentsia. Research and innovation would no longer be limited to the laboratories of developed nations, as developing nations could also have equal participation. Commercial clouds will have a pivotal role in realizing the goal of meta-universities. To support IT infrastructure of this scale, outsourcing will see an innovative pricing model, new governance models and novel partnerships.

### **Advent of mobile education:**

The education sector could leverage the development in telecom to make it more mobile. Technology has moved classrooms from brick-and-mortar rooms to desktops and laptops. SaaS solutions could be adapted to enable members of the Education ecosystem to access study material on mobile phones. The foundation for providing such services already exists; however, in order to realize its full potential there would be the need for collaboration between educational institutes, Cloud providers, software vendors and telecom providers.

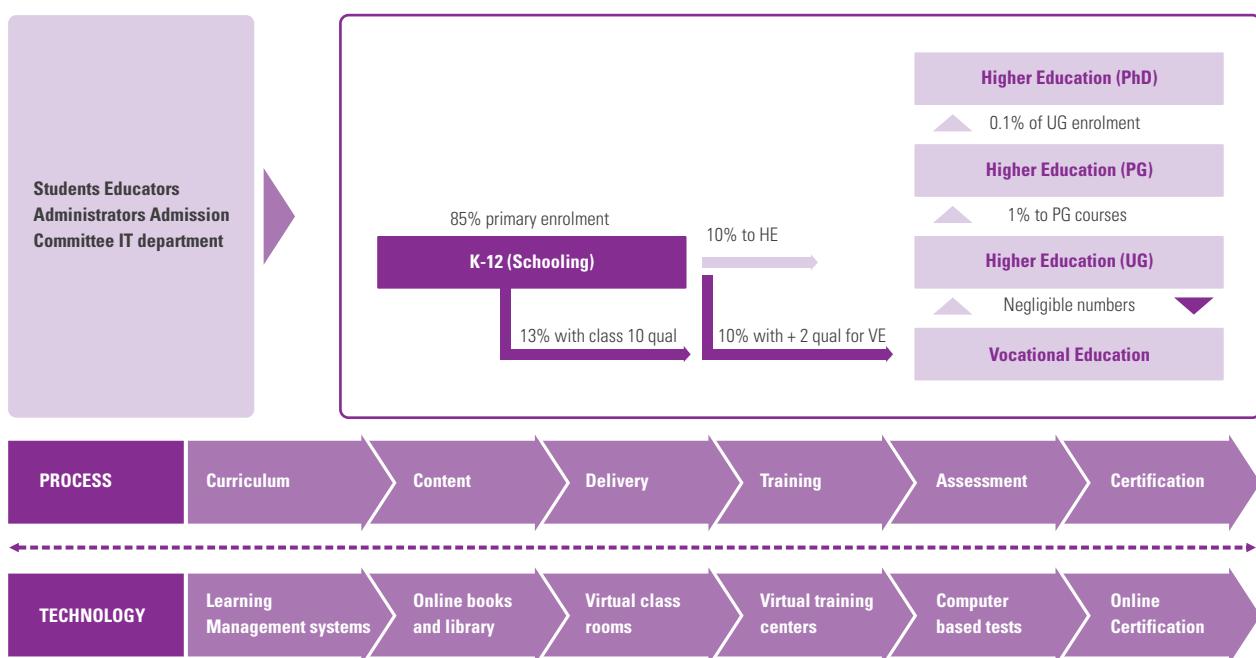
## Indian education sector and impact of the Cloud

Growth of the Indian economy in the recent past is forcing the education sector to step up the process of developing all the branches of the Education system. India's heterogeneous population of over a billion needs significant attempts to alleviate challenges of its education sector. While technology can play a significant role in accelerating the expansion in of the education sector in India, the digital divide hinders its reach.

The Ecosystem of the Indian education system is given in the diagram below.

**Indian education ecosystem and the role of technology**

Figure 06



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

Technology has only reached class room of urban schools, wherein it is again limited to computer labs and audio-visual rooms. Eighty percent of the teaching in India is still imparted without the use of technological tools<sup>16</sup>.

The Indian government is taking several steps to bridge the existing digital divide in the country. India has already moved eleven notches in Network Readiness Index (NRI) in 2010 over previous year<sup>17</sup>. The education sector in India is expected to step up its IT investment mainly in the areas of networking, basic infrastructure and security<sup>18</sup>. The sector is estimated to increase IT spending from USD 356 million in 2008 to USD 704 million in 2012, growing at a CAGR of 19 percent, during this period<sup>19</sup>.

With improving infrastructure, the Indian Education system is already making strides towards adopting the Cloud.

16. Educause.com  
17. inseg.edu

18. Study by Springboard Research  
19. economictimes.indiatimes.com/Springboard research

**The Cloud is enabling Indian educational institutes to afford state-of-the-art technology:**

Schools of technical education and engineering have played a significant role in the development of India as an IT outsourcing hub. To provide the students with upgraded skills and knowledge, schools need to be equipped with the latest software and hardware systems, which is an expensive and complex proposition for most Indian educational institutions. The Cloud could provide schools and universities with a cost effective solution that would enable them to afford latest technology at a lower cost.

**Case Example 08 - Engineering school in India adopts the Cloud for higher efficiencies**

Manjrasoft's Aneka is market oriented Cloud development and management platform with rapid application development and workload distribution capabilities. MSRIT, a Bangalore based engineering university installed Aneka on all the systems in its existing lab.

Students use Aneka to:

- Build distributed applications and learn implementing on this grid network
- Learn and implement the multiple programming models available in Aneka
- Carry out and mount their distributed applications on in-house grid and clouds

MSRIT was able to:

- Develop a grid network on its existing infrastructure using Aneka in a cost effective manner
- Meet the industry needs by using state-of-the-art technology in its institutions

**Source:** [manjrasoft.com](http://manjrasoft.com)

**The Cloud is expected to give a boost to online tutoring:**

Online tutoring is a thriving business in India. In small Indian towns such as Kasargod in the south and Faridkot in the north where career choices are limited, these jobs have become an important new source of income<sup>20</sup>.

At peak times, online tutoring vendors like TutorVista's teachers coach 2,500 American students in one-to-one sessions. There are still numerous technological challenges that confront these vendors regularly. With the advent of the Cloud these technical challenges would be passed on to Cloud service providers.

**The Cloud, through the use of telecommunications infrastructure, could help increase literacy rates in remote areas:**

Lack of infrastructure has been a major barrier in leveraging the advantage of ICT in rural education. Setting up the infrastructure to support technology is both time consuming and requires significant upfront investment from the government.

Even though infrastructural facilities have not yet reached remote areas in India, television and mobile telecommunication have better penetration rates. According to the Telecom Regulatory Authority of India (TRAI), there are over a 100 million rural mobile subscribers in India<sup>21</sup>. Solutions like VLE and mobile education can be provided through the use of the Cloud model as it has low upfront costs and the ability to support high volumes, which is well suited for supporting India's population. The Indian government could leverage the penetration of mobile communication and cable television along with benefits of Cloud services to take educational facilities to the remotest areas of the country.

**Case Example 09 - mLearning application to be used to teach english in rural India**

A joint outreach program undertaken by Carnegie Mellon University and the University of California, Berkeley, called Mobile and Immersive Learning for Literacy in Emerging Economies (MILLEE) seeks to support a group of English teachers in rural India with mLearning applications designed for grade-school students. The children access these activities via their mobile phones to work on English skills in the classroom as well as in the fields on days when they help with farm work.

**Source:** Educause, Mobile Apps for learning

**The Cloud can assist in increased collaboration between Indian and foreign universities:**

Universities from the US, Europe and Australia are planning to offer / are offering programs in collaboration with Indian universities. These universities seek to leverage the increasing demand of higher education in India to spread their international footprint. The Cloud could play an important role in the realization of these collaborative courses which will heavily depend upon VLE services and teleconferencing. At the same time, Universities could leverage the Cloud and benefit from low upfront investments and lower maintenance costs.



## Cloud for Small and Medium Enterprises (SMEs)

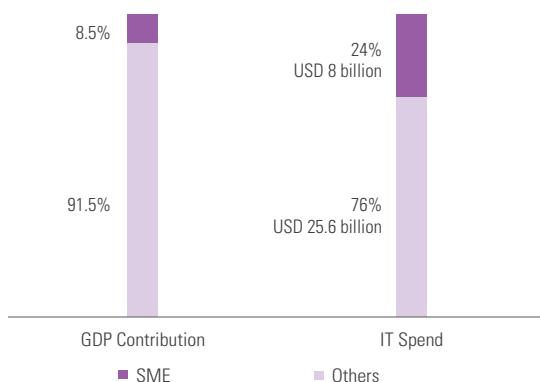
### Introduction

Across the globe, Small and Medium Enterprises (SMEs) play an important role in the economy of their country. They not only contribute to the GDP of their respective economies and add to employment, but also have the ability to influence governments to revise their policies. Large corporations are also now re-looking at their SME strategies.

In most countries, SMEs comprise around 90 percent<sup>1</sup> of all the enterprises. Registered SMEs account for approximately 45 percent of employment and 33 percent of GDP in emerging markets<sup>2</sup>.

**Contribution to GDP and IT spend by SMEs in India (2011 estimate)**

**Figure 01**



**Note:** i. GDP contribution based on Indian Ministry of MSME estimates  
ii. Government IT spend is estimated for SMEs with manpower up to 1,000 employees

**Source:** NASSCOM Strategic Review 2010, IDC

SMEs have played a vital role in the growth of the Indian economy despite facing significant challenges in their growth path:

- **GDP:**  
SMEs contributed to over 8-9 percent of the country's GDP in FY10. According to the Finance Ministry, the Indian SME sector is expected to contribute approximately 10 percent to the country's GDP<sup>3</sup>.
- **Employment:**  
The sector employs an estimated 72 million people spread over 30 million enterprises as of December 2010. The SME employment rate is growing at a faster pace than large organizations<sup>4</sup>.
- **Vertical focus:**  
SMEs are spread across all industries and verticals and are estimated to account for about 45 percent of the manufacturing output and around 40 percent of the total export of the country in FY09<sup>5</sup>.

- **Market dynamics:**  
With the increase in competition, SMEs can at times challenge and help reduce monopolistic tendencies of large organizations. However, the sector has restricted access to superior technology, skill-sets and marketing skills.
- **Innovation:**  
Even though the SME sector is faced with challenges such as skill shortages, they act as an incubation ground for the development of entrepreneurial skills and innovation.
- **Diversified growth:**  
Balanced development across the industrially backward regions of the country is induced due to growth of SME.

### Current role of IT within SMEs

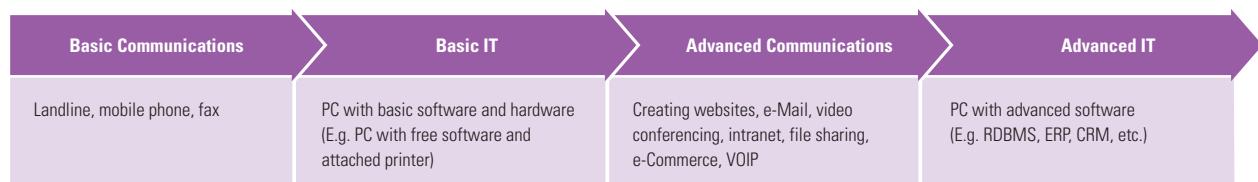
Even though the SME industry is quite significant in size, very few Indian SMEs have been able to leverage IT. Most of the SMEs typically rely on manual procedures. There is less automation and more of manual entries in maintaining information on inventory, suppliers, clients, etc. In such a scenario the data collected keeps accumulating without a systematic storage and retrieval mechanism in place. Moreover, the dependency on individuals rather than IT systems makes the process vulnerable.

Currently, the level of IT that gets used in SMEs is limited to basic applications like e-Mail, finance and payroll.

1. Indian Micro and Small and Medium Enterprises website: msme.gov.in
2. ftkmc.com Newsletter Nov 2010
3. Economic times, 'MSMEs contribution to GDP to rise to 10 pc'
4. KPMG estimates based on Indian Ministry of MSME's Annual Report 2009-10
5. Indian Micro and Small and Medium Enterprises website: msme.gov.in

## IT adoption in SMEs

Figure 02



**Source:** UNDP-SME and ICT: Asia-Pacific Development Information Programme e-Primers for the Information Economy, Society and Polity, 2007

Technology and IT usage in SMEs ranges from the basic communication tools like telephone and fax to complex software packages like ERP or CRM suites. However, not all SMEs require IT to the same level of complexity. Some require just the basic word processing capability, accounting, or printing. Others might have additional requirements like creating websites, sharing files or capabilities in e-commerce. Advanced IT is typically used by SMEs in the manufacturing sector. Manufacturing companies require technology to manage information such as bills of material, inventory checks/changes, workflow alterations, customer feedback and quality checks. However, several SMEs are wary about adopting IT in spite of their need.

The low level of IT penetration in the sector brings significant opportunity; however, SMEs face certain IT adoption challenges.

### Challenges for IT adoption in SMEs

SMEs are typically proprietor run businesses and the owners have been reluctant to make significant investments in IT due to the following reasons.

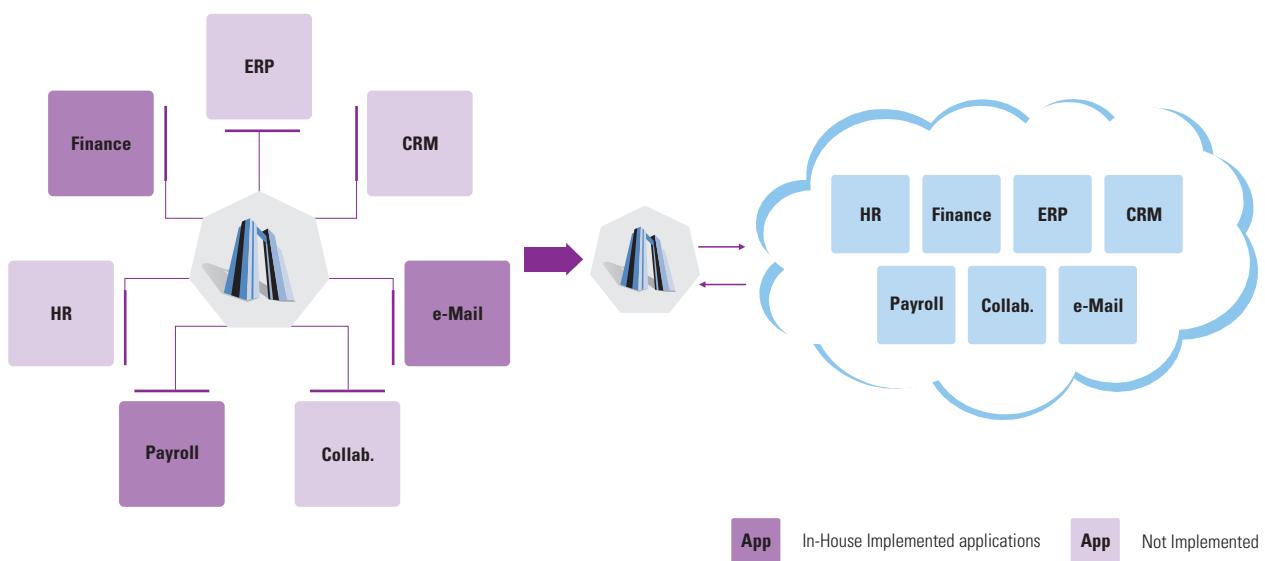
- **High financial costs and risks:**  
Immediate priorities and tightening economic situation push SMEs to invest in areas that directly improve revenue, efficiency or productivity. For e.g. Acquiring 100 PCs requires approx. USD 45,000 in India, which could be otherwise deployed in acquiring additional equipment, fleet, etc.
- **Lack of vertical specific solutions:**  
Generic software tools that do not cater to specific sub-verticals are pushed on to the SME by vendors. The opportunity cost of developing SME-specific IT solution in relation to large enterprises is high. This drives vendors to offer sector specific solutions to larger enterprises, but scaled down solutions built for large enterprises to the SMEs.
- **Vendor lock-in risk:**  
Once an IT solution is selected by a SME, there is too much dependence on solutions and services offered by the vendor. The SME is often apprehensive about the vendor escalating service or frequent technology upgrade costs. Due to such issues, the business owner chooses not to venture into advanced IT tools or try new technology.
- **Lack of IT skills:**  
A majority of Indian SMEs is not very IT literate. Therefore, upgrading technology or the IT infrastructure is perceived to be an area involving high risks. Such decisions, therefore, get delayed or procrastinated. Further, in most SMEs, skilled IT manpower is required for handling and maintaining advanced IT applications and tools. These skilled personnel are usually difficult to retain due to issues like lack of career progression, lower wages, etc.
- **Lack of SME focus by IT vendors:**  
The SME segment is quite fragmented, which calls for an overall increase in cost of sales for vendors. As the deal size doesn't commensurate this additional investment, IT vendors are not too keen to serve SME clients.

## Cloud adoption for SMEs

Traditionally SMEs were able to afford and manage only a few basic IT applications. However, with the introduction of the Cloud, SMEs are now able to access those applications that would otherwise require heavy investment if hosted in-house.

Wider application access for SMEs through the Cloud

Figure 03



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

Services that were typically and historically managed within the organizations are now offered today in a better, faster and more economical way through the Cloud.

SMEs in any vertical typically do not require very complex IT services or solutions. They have their own set of standards and ways of doing business, needing more flexibility and customization of software tools.

For SMEs who cannot afford owning software or IT infrastructure, the pay-as-you-go mode of the Cloud eliminates the necessity of managing IT in-house. By using the Cloud, a SME could transfer the 'risk' to the vendor. Moreover, with today's network infrastructure and technology, the Cloud seems quite attractive and reasonable.

**Case Example 01 - SME in media could see benefits of nearly 10 percent by the adoption of Cloud applications**

A small media firm that develops and publishes entertainment content could run about 80 percent of its websites and applications on the cloud thus simplifying its IT infrastructure management and turn its capital expenses to variable operating expenses thereby benefiting in cost savings of close to 50 percent.

**Source:** Financalexpress.com, 'SMEs push the cloud higher'

**Drivers and inherent business benefits of the Cloud**

The SMEs could find that adopting the Cloud is easier for them, than large organizations. Some of the key benefits that can accrue to SMEs by adopting the Cloud are:

- **Investments:** The Cloud allows the sharing of applications, software and other IT resources for enterprises on an On-Demand, Pay per use basis with little to no upfront investments. The enterprise, therefore, gets to turn their capital expense to a variable operating expense. This is an advantage for those SMEs that neither have the financial strength nor the willingness to commit too much capital to IT infrastructure.
- **Access:** The ability to remotely access solutions and applications anytime anywhere provides flexibility for SME to run their business.
- **Scale:** Managing the scaling up or down of IT systems is no longer a lengthy process. The option is now available On-Demand.
- **Manageability:** SMEs would not need a full-fledged in-house IT support team to manage the IT infrastructure thereby reducing costs.
- **Upgrades and Compliance:** Automatic upgrades and patches, and ensuring the latest solutions / applications are being deployed is the responsibility of the Cloud service provider/ vendor. The vendor also needs to ensure compliance with the changing statutory and regulatory requirements.

**Case Example 02 - SMEs can now run SaaS based ERP systems at lower cost**

A research on The Cloud usage involving 30 SMEs across sectors showed that the average amount saved by using the SaaS based ERP instead of the traditional ERP is about USD 822 per user per year for the SMEs. This proved the initial hypothesis of the research which stated that Cloud computing service provides lower per user annual cost than a traditional ERP system for a SME.

**Source:** Journal of Computing, Volume 2, Issue 5, May 2010, ISSN 2151-9617

**What will the SMEs use via the Cloud?**

The SMEs are more inclined to procure IT as a service with a view to reduce the overall total cost of ownership. The Cloud-based SaaS model perfectly suits this requirement. Additionally, the SMEs are not usually burdened with legacy IT infrastructure systems which could pose a problem during migration to the Cloud.

SMEs are increasingly demanding solutions that are hosted and offer a subscription-based option. SaaS has become a reality for the demographically-spread Indian SME sector. This has been due to a) the growing broadband penetration in tier II and III cities and rural India, b) a rise in cheaper

Several small and major IT players are introducing applications for the SMEs. Some recent partnerships that were forged to cater to the Indian SMEs were:

- Hewlett-Packard India (HP) and Bharti Enterprises' plan to offer Cloud services aimed at small-time application developers and SMEs in tier II and III cities catering to healthcare, hotels, textiles and the co-operative segment.
- Zensar and Microsoft partner to launch web-based ERP solution offered via the Cloud for the SMEs in automotive, leather and textile industries

**Source:** Economic Times, Zensar website

smartphone availability and usage, and c) declining computer hardware costs. SME spending in India on SaaS is expected to rise by around 43 percent in 2011<sup>6</sup>. Moreover, 60 percent of the applications used by SMEs are expected to be used on a shared basis like through the Cloud, in the next few years<sup>7</sup>.

One of the first things that SMEs can use via the Cloud is moving their website hosting and e-Mail services. With a small monthly fee, going as low as USD 35 to USD 50, SMEs can have their website hosted remotely and avail of e-Mail services along with SPAM filtering for the entire company's website, e-Mail, File Transfer Protocol (FTP) services, etc.

SMEs can use free services such as Google e-Mail and/or Google Apps for word-processing and spread-sheets or Open office. Software like Microsoft Shared View could be used free for web demos<sup>8</sup>. There are also CRM or ERP suites like Zoho CRM or NetSuite's ERP Cloud software suite which are widely accepted as cheaper alternatives. However, due to an increasing number of players in the field the SMEs might get confused and need to be more diligent in choosing the right vendor to reap benefits from the use of Cloud services.

#### **Case Example 03 - Tirupur exporters harness power of The Cloud to increase efficiency and reduce costs**

Exporters from the USD 2 billion knitwear industry of Tirupur in India will be using The Cloud from February 2011. They will use a common software platform on a pay-as-you-go basis to reduce operational costs and compete effectively with business rivals from Bangladesh and China.

After evaluating several solutions from global providers the e-readiness centre (ERC) in Tirupur, an organization that helps exporters leverage technology, has decided to go with a special purpose vehicle called G-Tech Solutions (an ERP software that will help exporters manage their production, marketing, supply chain and demand forecasting processes). The solution is provided by **Ramco Systems** and **HCL** will customize it and manage the data centre which will host the application. The entire project will require an investment of around USD 20 – 40 million.

By paying a one-time subscription of INR 10,000 (~USD 220) and monthly charge of INR 3,200-3,500 (~USD70 – USD80) for each user, exporters will be able to avail services related to HR, procurement and inventory, among others. Some exporters are finding the running costs of similar ERP packages too high and are considering migration to The Cloud model. Additionally, MNCs like Microsoft and SAP were offering similar solution at a higher rate of around USD200 per user per month. This was another reason to select Ramco's solution.

The Cloud will help the 4,000 odd small and medium exporters track their shipments in real time through computers or mobiles and can save around USD 220 million annually which is otherwise spent due to delayed shipments and supply chain inefficiencies.

**Source:** Economic Times, 'Tirupur takes to cloud to cut costs'

## **Conclusion**

Ease of use, affordability and ability to customize are the primary things that a SME looks for while choosing an IT solution. SMEs are not inclined towards significant capital investments in hardware and software. At the same time they do not have the requisite skill-sets to implement the complex IT solutions. The Cloud could help the SMEs in reducing IT investments considerably enabling rapid time-to-market and helping them become more productive, more competitive and more profitable.

Vendors have begun offering various SaaS solutions that can be quickly adopted by SMEs at a low cost. This would enable the SME to immediately leverage technology for business purposes. The introduction of the Cloud promises to level the technology field, enabling the SMEs to compete effectively with large organizations, and possibly unleashing a new wave of market innovation.

6. AMI-Partners.com, 'Growth of mobility, telecommuting, broadband and ecosystem infrastructure emerge as some key cloud computing drivers, says AMI'

7. The Economic Times, 'HP, Bharti in talks to offer cloud services for SMBs'

8. NASSCOM Emerge



# Migration

## Introduction

Given the benefits of the Cloud, many organizations have, in principle, decided to migrate to the Cloud. However, due to the rapidly evolving Cloud market and dynamic technical information, most organizations are unsure on how to proceed with the migration into the Cloud. One of the biggest challenges organizations contemplating Cloud adoption face is where to start and what to focus on. Further, depending on the type of enterprise e.g. SMEs, government or large corporations, the challenges and migration process would vary.

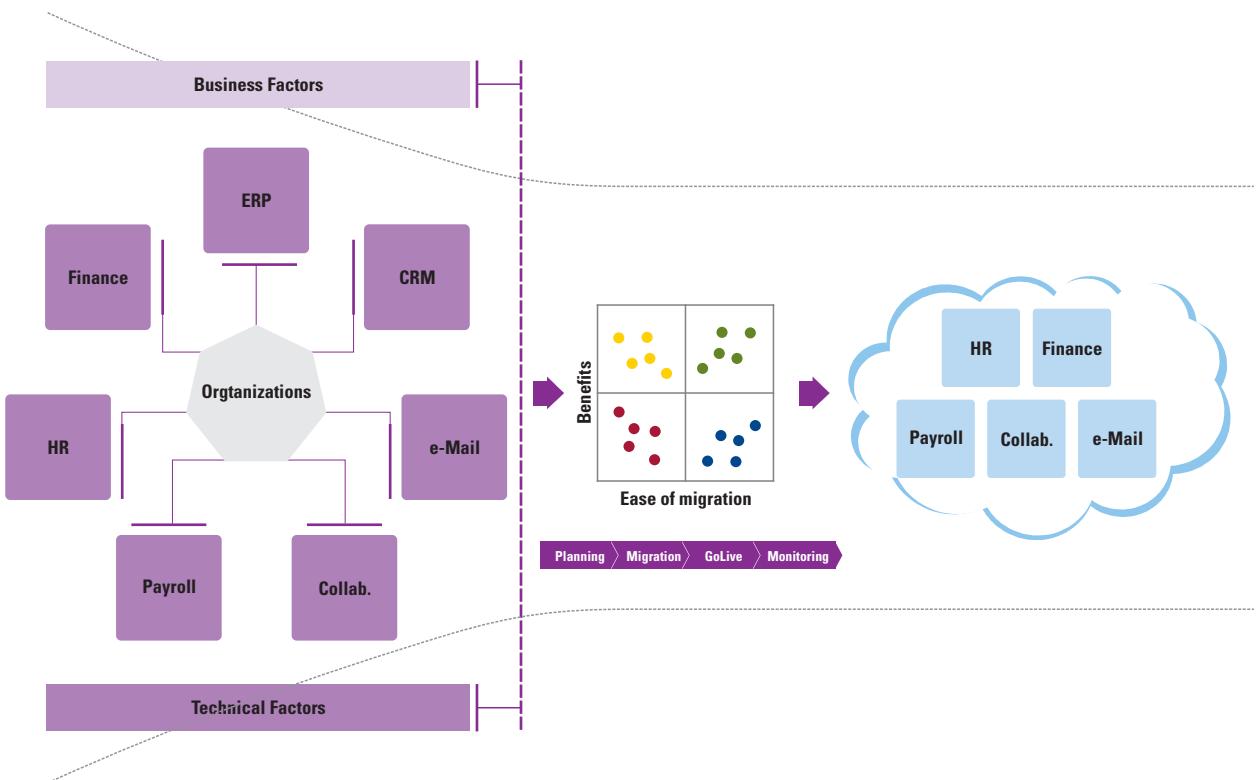
This section aims to provide an understanding of migration challenges. It also seeks to provide guidance on the steps that various types of organizations could follow to migrate to the Cloud.

## Migration considerations

All applications as well as the supporting network infrastructure may not be suitable for migration onto the Cloud. There are both business and technical factors to consider while evaluating the suitability of an application and infrastructure for Cloud migration. A typical Cloud migration process is depicted below.

**Cloud migration process**

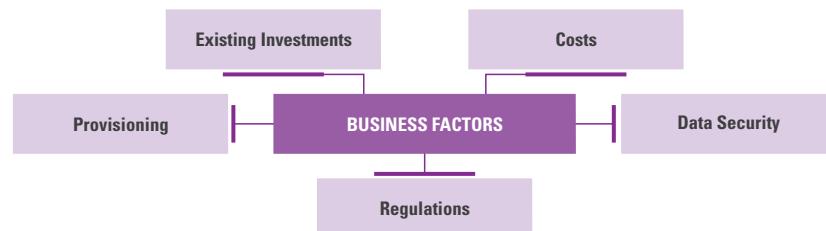
**Figure 01**



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

## Key considerations for migration

Figure 02



**Source:** KPMG's The Cloud: Changing the Business Ecosystem, 2011

### Business Factors

The key business factors to consider when moving to the Cloud are as depicted below:

- **Existing investments in IT:**

SMEs are definitely at an advantage over large organizations when it comes to Cloud migration. Due to a considerably limited installed IT base, SMEs may be able to directly move into the Cloud. Applications that were earlier out of reach for SMEs due to cost and complexity concerns are now available owing to the Cloud "OPEX" model.

Most large corporations, however, have already made significant investments in their IT infrastructure. Huge investments and complexity of hardware, network, application support, administration customization and integration would make it difficult for them to move away from their existing IT environment before the end of the life of the systems in the Cloud.

- **Costs:**

The existing cost model for IT is a combination of CAPEX and OPEX. Organizations generally budget for peak loads incurring higher CAPEX. However, these costs while being high are budgeted and predictable. Moving to an OPEX model through the adoption of the Cloud would mean paying for resources as per usage. This model implies unpredictable OPEX costs especially for those applications with varying demand for e.g. public facing websites.

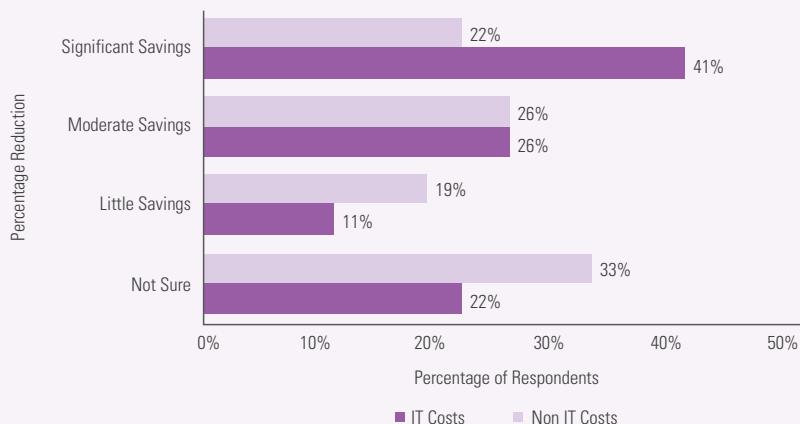
Therefore, it is important for organizations to estimate application usage and OPEX costs before moving to the Cloud. An example of this is the slow uptake of online backup Cloud applications due to the huge cost incurred due to usage based billing. However, in order to make the offering more attractive, vendors are now moving to a fixed-cost model. Further, migration costs need to be understood and factored in before making the decision to move into the Cloud. Failure to do this could negate the cost savings that are sought to be derived from the adoption of the Cloud.

## Survey Findings 01

### Expected cost savings from an implementation of the Cloud

Overall, more than 60 percent of the initial respondents, of KPMG in India's Cloud Computing survey, are of the view that an implementation of the Cloud could play an important role in reducing IT expenditure. Forty one percent of respondents expect significant cost savings in IT budgets (more than 25 percent) with the use of Cloud.

### Expected Percentage Reduction in Costs Through Cloud



\* Please refer the note on KPMG in India's Cloud Survey on Page 06.

**Source:** KPMG's The Cloud: Changing the Business Ecosystem, 2011

- **Data security:**

Security of data is a key concern while considering the move to the Cloud. Applications that have very sensitive and confidential information would be better off being behind the corporate firewall. Data with greater security tolerance however could be ported onto the Cloud. Technical mechanisms for data security in the Cloud are still evolving and security of data is still the top most inhibitor of Cloud adoption.

- **Regulations:**

Geopolitical issues especially for Governments and financial institutions should be carefully evaluated before making the transition to the Cloud. In the Indian context this is especially relevant as most Cloud datacenters are not located within the country. Typically local laws would apply to the data centers created in countries like the US, Singapore, etc. For e.g., the US Patriot Act would be applicable on Cloud datacenters located in the US thereby making India-specific data subject to scrutiny by US authorities. It is also important to ensure that local regulations relevant to each organization should be adhered to before deciding to move to the Cloud.

- **Provisioning:**

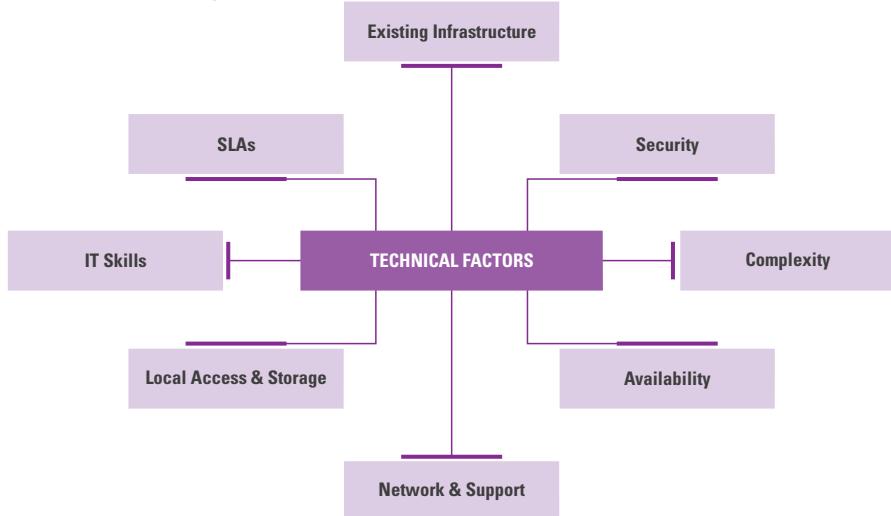
One of the key benefits of the Cloud is the quick provisioning of resources. Applications that need to be quickly available and scaled up rapidly based on demand are ideal candidates for the Cloud. Most organizations have business requirements that need to be supported by quick provisioning of IT data, e.g. an organization running a limited period online marketing campaign. Several applications are seasonal in nature as well for example HR and Payroll applications, which need resources to be processed only during certain periods. These sorts of applications can make use of the ability of the Cloud to quickly provision resources.

## Technical Factors

The key technical factors to consider when moving to the Cloud are as depicted below:

**Technical considerations for migration**

Figure 03



**Source:** KPMG's The Cloud: Changing the Business Ecosystem, 2011

Some of the other key technical aspects to be considered are:

- **Existing infrastructure:**

Typically, the IT architecture is optimized to cater to the current IT landscape. Moving to the Cloud would necessitate a change in the IT architecture. For e.g., corporate WANs<sup>1</sup> are optimized to serve up applications hosted on an internal datacenter. In this case, the WAN architecture would need to be re-assessed and re-designed to support the delivery of Cloud applications.

With applications moving into the Cloud, the way IT is delivered to end users would undergo a radical change. Some end user support would be dependent on the Cloud service provider response. Hence, organizations would have to concentrate on building vendor management competencies. Additional diligence would be needed to understand and mitigate vendor risks such as lock-in and vendor failure.

- **Security architecture:**

Application security and controls would need to change to adapt to the Cloud ecosystem. New types of mechanisms would be required to secure data in transit and at rest. Identity and access management mechanisms would need to be adapted to Cloud deployments. Further, data encryption mechanisms and key management for the Cloud are yet to mature. Network transport security such as Secure Sockets Layer (SSL), Transport Layer Security (TLS) would need to be built into applications while digital signatures could be required for ensuring data integrity.

- **Complexity:**

Simple applications can be easily migrated to the Cloud and the amount of effort required to move such applications may not be too significant. These applications can be directly migrated to SaaS applications already available from various vendors. E.g. e-Mail applications can be directly ported onto Cloud offerings like Office365, Google Apps or Lotus Live. Similarly, moving a simple web server to an IaaS platform may not require as much effort.

Migration of complex applications however, needs elaborate planning and testing prior to implementation. Legacy applications and existing enterprise applications could require code changes to work on the Cloud. Applications with high level of integration using advanced middleware bring

1. Refer to glossary

further complexities. An indication of how expensive this may be can be gauged from experience of the Y2K issue<sup>2</sup>. In that case, a single field change could necessitate a huge amount of planning and testing. Even if no code changes are required to such application for migration to the Cloud, planning, negotiation, testing for risk mitigation is required which is expensive. Further, the current Cloud architectures are dissimilar from the common enterprise architectures that are deployed currently.

One of the other key factors while considering moving an application to the Cloud is whether the application is well bounded or highly integrated. The greater the amount of integration points/interfaces, greater is the effort in migration of the application to the Cloud. Other considerations would include database, Lightweight Directory Access Protocol (LDAP) and middleware integration.

Further, most enterprise applications have complex databases supporting them at the back end. These may include use of automated features such as triggers. The complexity of the database architecture is one of the determining factors for Cloud migration.

- **Availability:**

Traditional arrangement for disaster recovery would need to be reconsidered for applications that are migrated to the Cloud. The current processes would need to undergo changes to reflect the move to the Cloud. Further, while the Cloud promises to take care of disaster recovery planning for organizations, Cloud outages still point to the need to plan for disasters. Organizations would need to consider having backups of their Cloud data and applications at alternate locations at least until Cloud data recovery is proven and tested over a period.

Latency of the application is important especially for client-facing applications. Planning and testing for low latency for web applications is an important consideration when migrating to the Cloud.

- **Network and support:**

With applications moving to the Cloud, there is a real risk of the network becoming the single point of failure. Further, due to a large number of connections to the external Cloud, the bandwidth may need to be upgraded. Hence, organizations would need to plan for better and reliable network connections to the Cloud. This could mean that organizations may incur higher costs for additional and higher capacity network connections. Further, a higher level of support would be required of telecom providers to ensure that any downtime is minimized.

- **Local access and storage:**

Most enterprise applications have been programmed for local access and storage. With the virtualized and non-permanent nature of the Cloud, these applications would need re-designing so that they function on the Cloud.

Another aspect to be considered is the volume of data in enterprise applications. For e.g. ERP, analytics and CRM systems hold terabytes of data that cannot be moved quickly to the Cloud. These would need to be handled in a phased manner.

- **IT skills:**

Although the Cloud is based on existing technologies, it would require updated skills within the IT team, especially on architecture, implementation, develop and operation. For organizations not yet exposed to newer IT technologies like virtualization, Web 2.0 etc. the learning curve would be sharper. Further, migration of applications to the Cloud is perceived by IT teams as a loss of control. These types of cultural challenges would need to be addressed prior to deciding the migration to the Cloud.

- **Service Level Agreements (SLAs):**

Another key aspect to consider before migrating to the Cloud is whether Cloud service providers are able to provide SLAs that the business needs. This is quite essential considering the limited control organizations have over applications on the Cloud. SLAs need to address the concerns of availability, confidentiality and integrity of the application. Further, it should clearly outline service provider responsibilities and penalties for failure to meet agreed service levels.

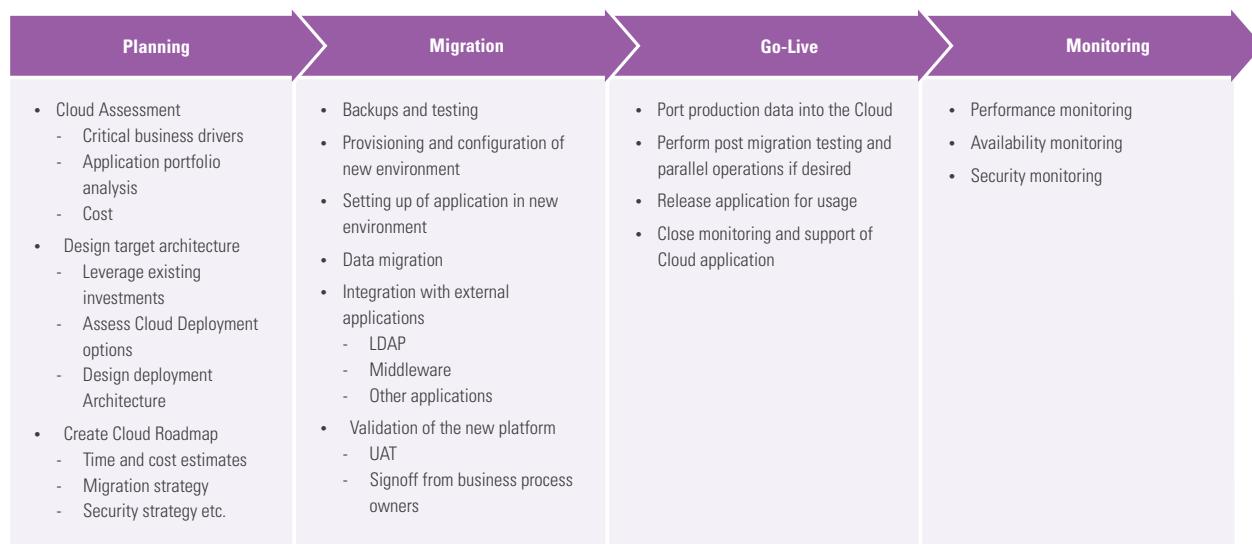
2. Refer to glossary

## Cloud migration approach

As is evident from the above business and technical considerations, migration to the Cloud needs detailed assessment and planning. A typical approach to Cloud migration is depicted below:

**Cloud migration approach**

**Figure 04**



**Source:** KPMG's The Cloud: Changing the Business Ecosystem, 2011

### Phase 1: Planning

In the planning phase, a detailed assessment is carried out of the existing IT environment with a view to understand the applications that are appropriate for moving into the Cloud. The migration considerations mentioned earlier in this chapter would be taken into account. Once candidate applications are identified for migration, a detailed Return on Investment (ROI) and Total Cost of Ownership (TCO) assessment is carried out to understand the cost benefits that will be achieved from the migration.

### Phase 2: Migration

In the migration phase, the applications selected will be ported to the Cloud and tested in a structured manner. Simple applications like e-Mail would just need testing prior to migration in terms of functionality and performance. However bespoke and/or complex applications would need the creation of a development and test environment. Procedures similar to those followed during a Software Development Life Cycle<sup>3</sup>(SDLC) would need to be adopted prior to deployment of the application on the Cloud. Thereafter, validation of the new platform will be performed through User Acceptance Testing (UAT)<sup>4</sup> and signoff from business process owners.

### Phase 3: Go-Live

In the Go-live phase, the live production data will be ported onto the Cloud. This will be followed by post-migration testing and release. During this phase, a higher degree of monitoring and support is essential to handle any unforeseen issues. Some organizations may choose to adopt a parallel operation approach before fully moving to the migrated application.

### Phase 4: Monitoring

A key requirement for Cloud migration is post-migration monitoring. Given the shared nature of the Cloud, it is necessary to monitor Cloud application in terms of performance, availability and security. There are various monitoring tools being provided by Cloud vendors. These include Amazon CloudWatch, Gomez, Hyperic/CloudStatus, Nimsoft (now acquired by CA). These tools can help IT teams detect breaks in SLAs and take the necessary corrective action.

3. Refer to glossary

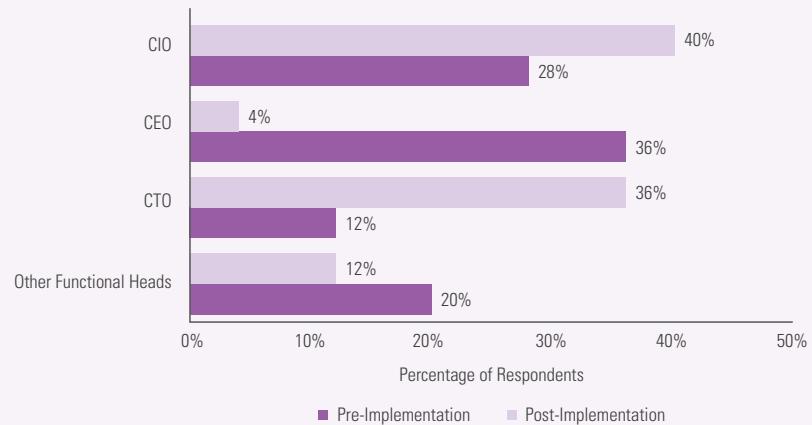
4. Refer to glossary

## Survey Findings 02

### Role of the leadership in managing the Cloud

A significant majority of the initial respondents, of KPMG in India's Cloud computing survey, are of the view that either a CEO or CIO should lead the process of adoption of The Cloud. Post implementation the management of The Cloud could be the responsibility of either the CIO (stated by 40 percent of the initial respondents) or the CTO (stated by 36 percent of the initial respondents).

### Who should be responsible for managing Cloud environment?



\* Please refer the note on KPMG in India's Cloud Survey on Page 06.

**Source:** KPMG's The Cloud: Changing the Business Ecosystem, 2011

### Industry specific considerations

While a standard approach (depicted in figure 04) can be used for migration of applications to the Cloud, Cloud migration will vary depending on type of organization. To illustrate the difference, we have considered three types of organizations as below:

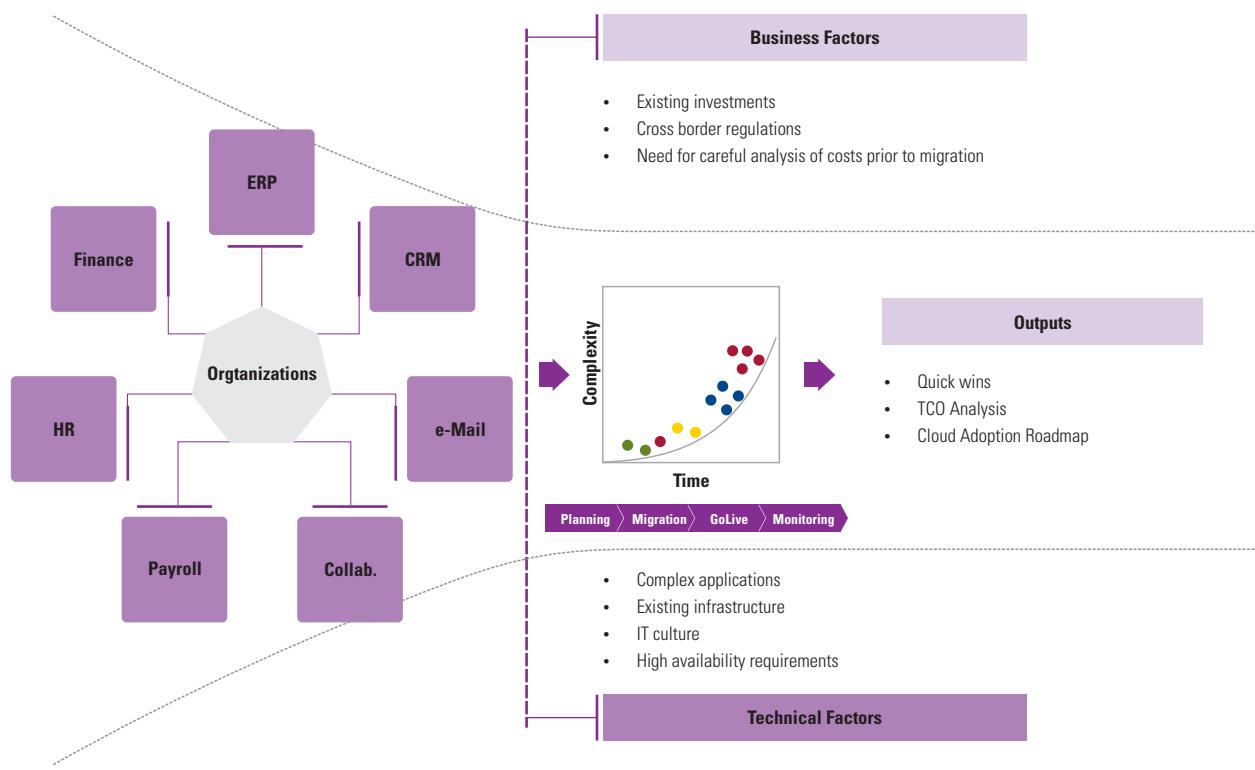
- Large organizations
- SMEs
- Governments

#### Large organizations

As mentioned earlier, large organizations already have significant investments in IT. Further, the IT environment tends to be much more mature and complex. For larger organizations to migrate to the Cloud, detailed assessments and planning would be required.

## Migration to the Cloud for large organizations

Figure 05



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

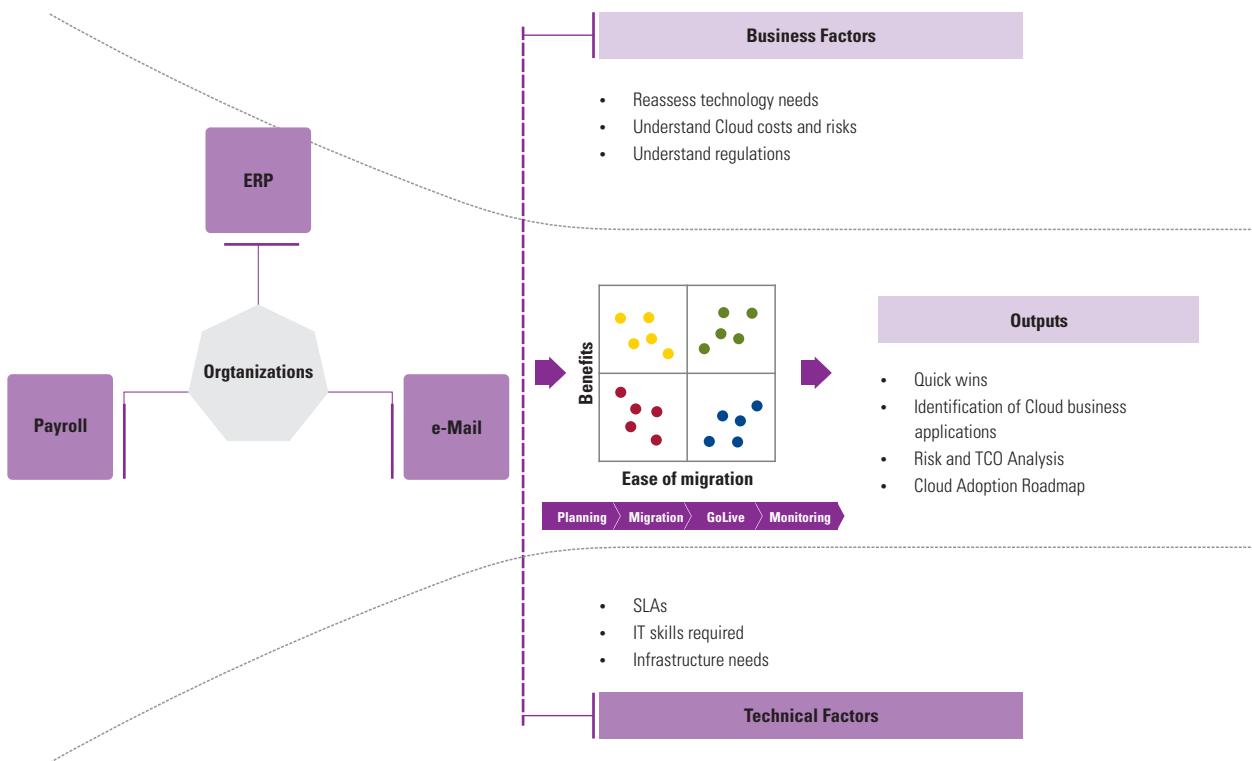
Simple applications like e-Mail and collaboration solutions could be immediately moved to the Cloud to derive the benefits. However, it would be worthwhile for organizations to wait for complex Cloud-based applications such as ERPs to mature before migrating to them. It would be beneficial for large organizations to draw up a roadmap for the gradual adoption of the Cloud instead of following a big bang approach. This would enable them to derive Cloud benefits over a period of time without having to write-off existing investments. A phased approach would also enable a graceful migration to the Cloud. Large organizations should nevertheless conduct a comprehensive Cloud assessment including a risk assessment of its applications to identify any applications that would immediately benefit by migrating to the Cloud.

### SMEs

SMEs have a major advantage in migrating to the Cloud as they do not have major investments in IT infrastructure. SMEs have the opportunity today to quickly move to the Cloud and reap the benefits of software like CRM, ERP, etc. which were hitherto the domain of only large corporations. They would need to follow a different approach for Cloud migration and adoption. They would need to re-visit their business needs that were ignored earlier due to non-availability/cost of technology. With the availability of a plethora of Cloud services, SMEs are in an enviable position to pick and choose the best-of-breed Cloud offerings. However, SMEs should nevertheless perform application and vendor assessments prior to signing up for any Cloud service. Most of the business and technical factors mentioned earlier hold true for SMEs as well. Given the evolving nature of the Cloud, SMEs should understand relevant risks of the Cloud prior to making the move.

## Cloud migration for SMEs

Figure 06



Source: KPMG's The Cloud: Changing the Business Ecosystem, 2011

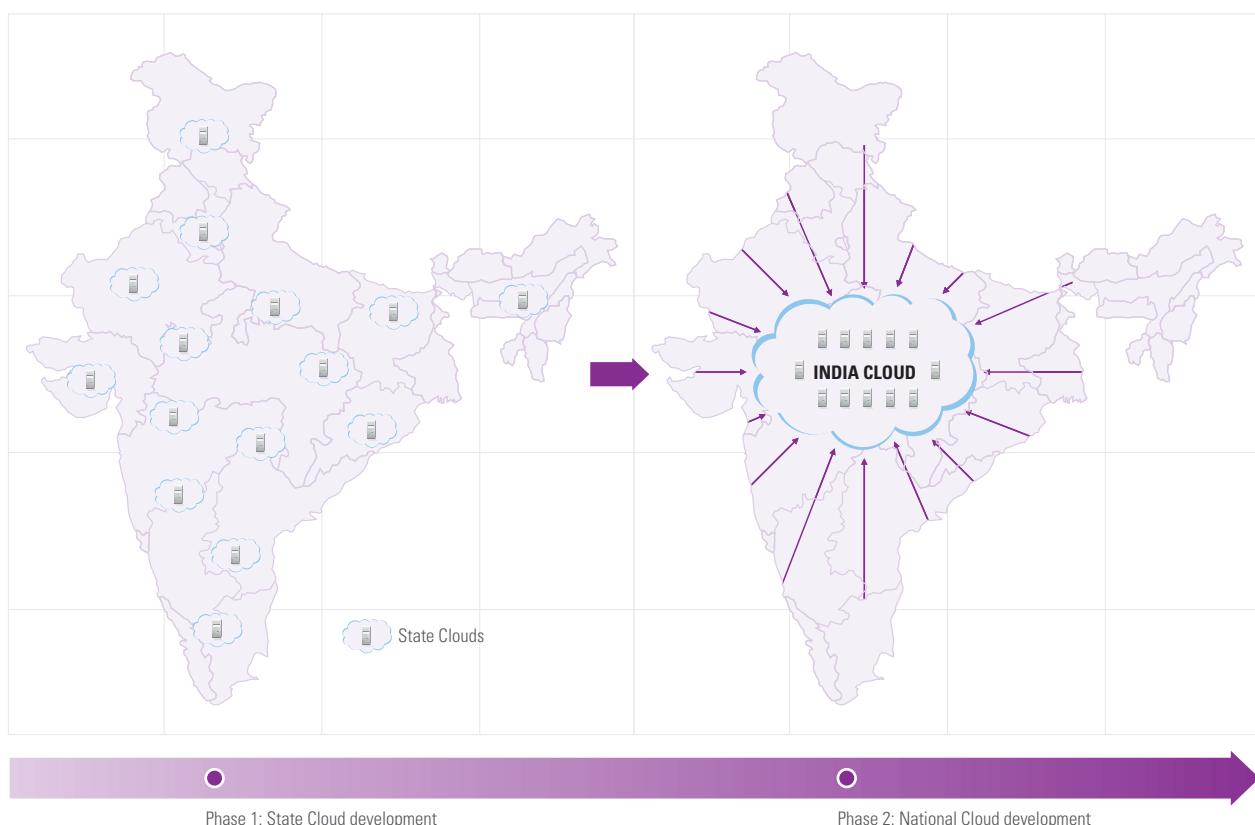
SMEs can use the benefits of the Cloud like 'pay per use' thereby leveraging the Cloud without any CAPEX investment.

### Governments

Governments across the world are looking at reducing IT infrastructure costs while retaining the control of data. While the US Government has already moved towards creating a Cloud for its use, other governments are mulling over their approach. In India, eGovernance has taken off in a big way. However, the underlying IT infrastructure still is State and Central datacenters. Creation of a private Cloud just for the Indian government's use seems to be a pragmatic way for efficient utilization of IT resources. Indian state and national governments have heterogeneous systems and many of them have limited computerization. Therefore, migration across Government or Government agencies would still be a distant dream. In such a scenario, it would be worthwhile to first consider consolidation of applications and infrastructure at a state level through the development of State Clouds. These Clouds would be based on nationally-defined Cloud standards. Smaller states could also share Clouds implemented in larger states. Once a sufficient degree of standardization is achieved across the states, it would be easier to implement a national Cloud.

## Migration to the Cloud within Indian governments

Figure 07



**Source:** KPMG's The Cloud: Changing the Business Ecosystem, 2011

Creation of Clouds for use by State and National Governments would result in several benefits including:

- Quick provisioning of IT infrastructure
- Efficient use of IT resources
- No need for disaster recovery sites for each data center
- Protection of data

## Conclusion

While the Cloud promises several benefits, migration to the Cloud needs to be meticulously planned. Depending on business and technical considerations, organizations need to select the appropriate applications and infrastructure for migration, as all applications and infrastructure are not suited for the Cloud. A phased approach to Cloud migration is required to move applications to the Cloud while navigating through various minefields. This would enable organizations to ensure that the costs of migration to the Cloud do not exceed its benefits. Further, different types of organizations for e.g. SMEs, large corporations and Governments need to consider factors relevant to themselves before embarking on this journey. To summarize, the Cloud holds promise for all types of organizations. However, different approaches are required by each organization to leverage the Cloud effectively.





# Tax Implications

## Introduction

The tax laws and rules in force currently in India are not specifically designed to deal with highly automated transactions such as the Cloud. Nevertheless, these laws and rules govern the taxability of Cloud services. Cloud services could come under the purview of both direct and indirect Indian tax laws as given below.

## Direct tax concerns

In case of those Cloud service providers, that are tax residents of India, determining the tax consequences of providing Cloud services would be relatively straightforward. The net income arising from such transactions would be liable to tax in India in their hands at normal tax rates.

However, the determination of tax consequences of Cloud services of foreign Cloud service providers, who are not tax residents of India, could be complex. The key issue that arises for consideration is the classification of the transaction conducted by the Cloud service providers, for e.g. whether the transaction will be classified as service, license, lease, etc. This classification would determine whether the income is in the nature of 'royalty' or 'fees for technical services' or 'business income'. If the income is 'royalty' or 'fees for technical services', it would be taxable in India in the hands of the foreign Cloud service provider on a gross income basis i.e. without allowing any deduction for the expenses incurred for earning such income.

However, if the income is characterized as 'business income', it would be taxable in India, only if the foreign Cloud service provider has any business connection or permanent establishment ('PE') in India and the income is attributable to such business connection or permanent establishment. In such a case, the income would be taxable in India on a net income basis i.e. after allowing deduction for expenses incurred for earning such income.

The characterization of the transaction would be equally important for the Cloud user for the purpose of determining its withholding tax liability in India. If the income of the Cloud service provider is liable to tax in India, the user would be obliged to withhold tax from the payments made to the Cloud service providers.

## Classification of transactions

### Royalty

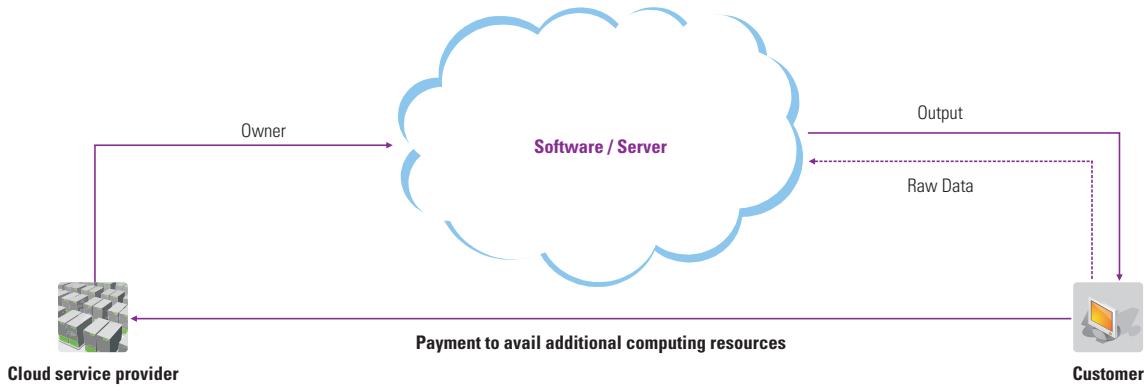
As per the domestic tax laws in India, the payments for following items inter alia are classified as 'royalty':

- Transfer of all or any rights (including the granting of license) in respect of secret formula or process or trade mark or in respect of any copyright or scientific work, etc.
- Use of any patent, invention, model, design, secret formula or process or trademark or similar property
- Use or right to use any industrial, commercial or scientific equipment.

Thus to be classified as 'royalty', payments towards the Cloud transactions should fall under any of the above categories.

Some examples of transactions that would not fall under the category of royalty are:

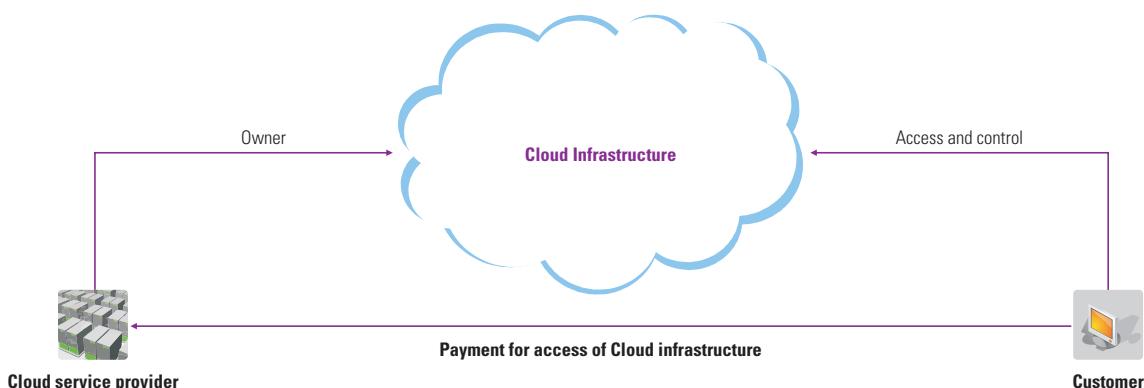
- a. A customer is entering into an agreement with a Cloud service provider for accessing software on the Cloud (SaaS or PaaS) of a Cloud service provider located outside India. The payment in this case is not for the use of 'copyright' in the software; but towards the use of a copyrighted article. The payment by the customer to Cloud service provider in such a transaction should not be characterized as 'royalty'.
- b. A customer hires a Cloud service provider to avail additional computing resources. The customer sends the data to the Cloud service provider to be processed using the service provider's computing infrastructure and software. The data is processed by the Cloud service provider, as per the specifications / requirements of the customer, and the results are sent to the customer in the form of a detailed electronic report constructed according to the customer's specifications. The same has been shown below in the form of a diagrammatic representation.



In the above transaction, the payment is not for the use of any equipment / software by the customer, as the Cloud service provider itself uses the equipment / software for processing the data. Further, such transactions neither involve the transfer of right in any process, trade mark, copyright, etc. to the customer nor does it involve use of any patent, process, etc by the customer. Thus, the payment by the customer to the Cloud service provider in such transactions should not be characterized as 'royalty'.

However, the following could be classified as a Royalty payment

A customer approaches a Cloud service provider for getting access to the Cloud. Under this arrangement, the Cloud service provider makes available a specific physical portion of the network to the customer on a dedicated basis. The customer is given the right and means to access and control the equipment. The customer uploads software and data onto the Cloud service provider's infrastructure and monitors the same remotely. A pictorial representation of this example is as below.



In the above case, since the customer uses the computing infrastructure and also has control over it, the payment in consideration thereof may be characterized as 'royalty', being payment for the 'use of equipment'.

### **Fees for technical services**

If the payment by the customer to the Cloud service provider is not considered as 'royalty' and is regarded as payment for services, the issue that arises is whether the payment is in the nature of 'fees for technical services'.

Further, it would be pertinent to examine whether payment for services like repair / maintenance and / or transition services from traditional servers to Cloud servers provided by the foreign Cloud service provider can be considered as 'fees for technical services'.

The term 'fees for technical services' is widely defined under the domestic tax law to mean payment for the rendering of any managerial, consultancy or technical services. In certain judicial pronouncements in India, the courts have taken a view that the payment for availing standard services, which are available to anybody willing to pay for it, cannot be regarded as 'fees for technical services', even if it involves the use of sophisticated equipment for providing the services.

Further, in one of the cases, the Delhi High Court has taken a view that fees for technical services include those services which involve a human interface. In other words, services provided through automated equipment (not involving human interface) should not be considered as fees for technical services.

Based thereon, it could be argued that the payment by the customer to a Cloud service provider is for availing standard services. These services are being provided by the Cloud service provider to its various customers, and hence, are not in the nature of 'fees for technical services'.

Further, as these services do not involve a human interface, it should not be regarded as fees for technical services.

### **Business income**

If the income earned by the Cloud service provider is neither in the nature of 'royalty' nor 'fees for technical services', it would be regarded as 'business income'. Such income would not be taxable in India in the absence of any operations carried out by the Cloud service provider / PE in India.

Typically, in a situation where the foreign Cloud service provider carries on business in India through an office or dependent agent or a subsidiary (say back office support, etc.), it may have an exposure of constituting PE in India. In a Cloud scenario, where customers across the globe can store and access their data and applications virtually from anywhere in the world, the PE implications of such transaction (based on degree of control over the server) would need to be evaluated.

India has entered into Double Tax Avoidance Agreements (DTAA) with various countries. If the Cloud service provider is a tax resident of a country with which India has entered into a DTAA, it may choose to be governed by the provisions of such DTAA, if they are more beneficial to him. In such a case, the tax consequences of the transaction would need to be determined based on the provisions of the relevant DTAA.

Another important aspect that needs to be looked into while dealing with taxability of the transaction would be the applicability of transfer pricing provisions. This needs special consideration in cases where multiple corporate entities combine efforts to provide Cloud services to customers.

The typical issues that could arise in determining the arm's length price for a Cloud service could relate to valuation of the Cloud based on intellectual property, infrastructure and personnel supporting the business.

## **Judicial precedents**

Characterization of income from the transactions has been a subject matter of debate and there are conflicting decisions of the courts on the subject.

There are several judicial precedents wherein it has been held that the payment for purchase of off-the-shelf software/ bundled software is not for use of 'copyright' in the software. It is, instead, towards the purchase of a copyrighted article and hence the payment is not in the nature of 'royalty'.

However, in a recent case the tribunal has not agreed with the view of the earlier decisions and has held the income from supply of software to be in the nature of 'royalty'.

In one of the cases, the payment made to the foreign company for accessing its CPU for processing of information was held by the Authority of Advance Rulings (AAR) as payment for use of secret software and hence, in the nature of royalty. Further, the AAR observed that the facilities such as online / analytical data processing provided by the foreign company to the Indian company would be for use of, or the right to use design or model, plan, secret formula or process. The payment for such facilities would hence qualify as royalty.

However, in another case, the payment made by an Indian company to a foreign company for processing of the data supplied by it was held by the tribunal as not being 'royalty' which could be taxed in India. This was because the payment was not made for use of any specialized software or for the use of mainframe computer of the foreign company. It was further held that even if the payment is regarded as payment towards use of software, the payment made was not for a copyright, but for a copyrighted article.

In one of the cases, the payment for use of software on server platform of the foreign company was held to be payment for use of scientific equipment and therefore, in the nature of 'royalty'.

However, in another case, the payment for obtaining access to software applications and server hardware system hosted by the foreign company was held to be payment for availing a facility provided by foreign company. This was not held as a right to use equipment located abroad, especially since the server was not dedicated to the Indian company. Accordingly, the payment was held not to be in the nature of 'royalty'.

## Indirect tax concerns

As discussed above, the classification of the Cloud as a service or transfer of right to use property is of utmost importance, because it decides which authority will levy the taxes and the applicable tax rates.

If the transaction qualifies as a service, the authority to levy tax lies with the Central Government and the present service tax rate is 10.3 percent. However, if the transaction qualifies as a transfer of right to use property, then the authority to levy tax lies with the various state Governments, with the generic tax rates ranging from 4 percent to 13.5 percent across various states.

Typically most services of the Cloud, such as provisioning of space for data storage, would not involve transfer of right to use property and hence would qualify as a service transaction on which service tax would be applicable. This would include cases where customer enters into an agreement with Cloud service provider for accessing software on a servers managed by the Cloud service provider; or where the customer hires Cloud service provider for availing extra computing capacity and the data processing is done by the Cloud service provider.

However, in the aforementioned case discussed above, where the Cloud service provider makes available a specific physical portion of the network dedicated to the customer and the customer is given the right and means to access and control the equipment vis-à-vis the activities conducted by it, may constitute rental income. This is because a temporary and exclusive use of a specific portion of Cloud service provider's property is being transferred to the customer. In this case the state level tax, VAT<sup>1</sup>, could be applicable. It also thus becomes essential to determine which state would have the right to levy tax (VAT). This would depend on where the agreement is performed or where the server / equipment is located.

In a Cloud service, where both the parties (the Cloud service provider and the customer) are in India, the liability to service tax or VAT (as the case may be) would be on the Cloud service provider. However, where the transaction involves either of the parties being situated outside India (either the Cloud service provider or the customer), then the liability to service tax would depend on where the service is provided from or the location of customer.

1. Refer to glossary

This is crucial because, in case of a foreign Cloud service provider providing the service from outside India, the liability to discharge the service tax would be on the customer in India. Similarly, the liability to pay VAT where the transaction involves either of the parties being situated outside India (either the Cloud service provider or the customer) would depend on where the agreement is executed or where the server / equipment is located.

### **Goods and Service Tax (GST)**

The issue of classification of Cloud services may continue to be a matter of discussion even under the proposed Goods and Service Tax ('GST') regime (proposed to be introduced from 1 April 2012). The GST would replace a variety of indirect taxes at the Central and State level, including service tax and VAT.

However, the tax rates applicable to a service transaction and to a transaction of transfer of right to use property are proposed to be different in the first two years of GST implementation. These will finally converge to a common rate from the third year onwards.

### **Conclusion**

As far as direct taxation goes, not enough guidance is available in the law vis-à-vis the tax treatment of the provision of such services due to the nascent nature of the Cloud. Further, the jury also seems to be divided on the tax treatment of such transactions. Cloud service providers and customers would need to examine the tax / withholding tax implications in India, with regard to the nature of the transaction in each particular case. The Cloud service providers and customers may consider the option of obtaining an advance ruling on the tax treatment of transaction to have clarity and certainty vis-à-vis the tax implications in India.

From an indirect tax perspective, while typical Cloud service providers may not have to worry about classifying their transactions as a service, Cloud service providers desiring to undertake transactions qualifying as a transfer of right to use, would have to carry out careful planning to achieve a dispute free tax treatment.





# Glossary

## Definitions

- **3G Technology**

3G is the 3rd generation of standards for wireless technology. For a technology standard to be called 3G, it must allow simultaneous use of voice and data services at a minimum peak data rate of 200 kbit/s

- **4G Technology**

4G is the 4th generation of standards for wireless technology. It is an evolution from 3G and must allow minimum peak download speed of 100 mbit/s for high mobility communication (such as trains and cars) and 1 Gbit/s for low mobility communication (such as stationary users and pedestrians). Currently LTE and WiMAX are the two technologies that come under 4G umbrella

- **Application Programming Interface**

An Application Programming Interface (API) is a particular set of rules and specifications that a software program can follow to access and make use of the services and resources provided by another particular software program that implements that API. It serves as an interface between different software programs and facilitates their interaction, similar to the way the user interface facilitates interaction between humans and computers.

- **Blade Servers**

Blade servers are servers with modular designs to save costs and power consumption.

- **Business Process Execution Language**

Business Process Execution Language (BPEL) defines a notation for specifying business process behavior based on Web Services. Business processes can be described in two ways, executable and abstract. BPEL is used to model the behavior of both executable and abstract processes.

- **CAPEX**

CAPEX are funds used to acquire or upgrade capital IT assets such as hardware printers, servers, laptops, networking equipment, etc.

- **Cloud Computing Interoperability Forum**

The Cloud Computing Interoperability Forum (CCIF) was formed in order to enable a global cloud computing ecosystem whereby organizations are able to seamlessly work together for the purposes for wider industry adoption of cloud computing technology and related services. A key focus will be placed on the creation of a common agreed upon framework / ontology that enables the ability of two or more cloud platforms to exchange information in a unified manner.

- **Distributed Management Task Force, Inc.**

Founded in 1992, the Distributed Management Task Force, Inc. (DMTF) is the organization bringing the IT industry together to collaborate on systems management standards development, validation, promotion and adoption. DMTF enables a more integrated and cost effective approach to management through interoperable solutions.

- **Electronic Health Record**

Electronic Health Record (EHR) is similar to Electronic Medical Record (EMR) and is sometimes used interchangeably with EMR. However, EHR is now the preferred term because its definition includes the ability to exchange information interoperably while EMR does not necessarily imply that ability.

- **Electronic Medical Record**

A real-time patient health record with access to evidence-based decision support tools that can be used to aid clinicians in decision making. EMR does not necessarily imply the ability to exchange information interoperably.

- **eSignatures**

An electronic signature is any electronic means that indicates that a person adopts the contents of an electronic message. The US Code defines an electronic signature for the purpose of US law as "an electronic sound, symbol, or process, attached to or logically associated with a contract or other record and executed or adopted by a person with the intent to sign the record"

- **FDA**

Food and Drug Administration (FDA), a US federal agency in the Department of Health and Human Services established to regulate the release of new foods and health-related products.

- **Federal Information Security Management Act**

The Federal Information Security Management Act is a US federal law enacted in 2002 which recognizes the importance of information security to the economic and national security interests of the United States.

- **Healthcare ecosystem**

In the context of our publication, healthcare ecosystem consists of hospitals and other institutions, nurses, doctors, dentists, medical administrators, government agencies, voluntary agencies, non-institutional care facilities, pharmaceuticals and medical equipment manufacturers, and health insurance companies.

- **Health Insurance Portability and Accountability Act**

The US Office for Civil Rights enforces the Health Insurance Portability and Accountability Act (HIPPA) Privacy Rule, which protects the privacy of individually identifiable health information; the HIPAA Security Rule, which sets national standards for the security of electronic protected health information; and the confidentiality provisions of the Patient Safety Rule, which protect identifiable information being used to analyze patient safety events and improve patient safety.

- **Hospital Management Information System**

Hospital Management Information System (HMIS) is a system that provides seamless integration of machines used in the hospital diagnostic practices. An e.g. of HMIS is Picture Archiving and Communication System (PACS) that covers the day to day back office to front office operations of the hospital ranging from patients to the stakeholders of the hospital ensuring proper management of hospital administration ensuring a best possible Return on Investment (ROI).

- **Information Communication Technology**

Information Communication Technology (ICT) is often used as a synonym for information technology (IT) but is usually a more general term that stresses the role of telecommunications (telephone lines and wireless signals) in modern information technology.

- **Learning Management System**

A learning management (LMS) is a software application for the administration, documentation, tracking, and reporting of training programs, classroom and online events, e-learning programs, and training content.

- **Meaningful use**

Meaningful use describes the set of requirements that hospitals and physicians must meet to qualify for US Medicare or Medicaid incentives and avoid future penalties regarding their use of certified EHR technology.

- **mGovernance**

mGovernance or Mobile governance involves the utilization of all kinds of wireless and mobile technology services, applications and devices for governance.

- **Network Readiness Index**

The World Economic Forum's Networked Readiness Index (NRI) measures the propensity for countries to exploit the opportunities offered by information and communications technology. It is published annually. The NRI seeks to better comprehend the impact of ICT on the competitiveness of nations.

- **Office of the National Coordinator**

Office of the National Coordinator (ONC) for Health Information Technology at the US Department of Health and Human Services

- **OPEX**

OPEX are Funds used on the operational aspect of running the CAPEX such as telephone service, leased network lines, fees for internet hosting, data center rack space, and offsite backup.

- **Para-Teachers**

The term para-teacher is a generic term applied to characterize all teachers appointed on contract basis often under varying service conditions in terms of emoluments and qualification requirements. They are also referred as contract teachers.

- **Personal Healthcare Record**

Personal Healthcare Record (PHR) sometimes referred to as a patient-controlled health record (PCHR). A personal health record is an electronic record of health-related information about an individual that conforms to nationally recognized interoperability standards and that can be drawn from multiple sources while being managed, shared, and controlled by the individual. A personal health record could contain all health information from all of a person's physicians and specialists. It could include records of immunizations and prescriptions, as well as lifestyle improvements, such as smoking cessation, exercise and nutritional improvements. A PHR is controlled by the consumer who may or may not grant other entities access to it.

- **Picture Archiving and Communication Systems**

Picture Archiving and Communication Systems (PACS) is a machine used to store electronic images generated by machines during diagnoses and storing data against a particular patient's record for use and for reference in the future.

- **Protected Health Information**

Protected health information (PHI) under HIPAA includes any individually identifiable health information. Identifiable refers not only to data that is explicitly linked to a particular individual (that's identified information). It also includes health information with data items which reasonably could be expected to allow individual identification.

- **Remote monitoring**

Remote monitoring is the electronic transmission of health care data either entered directly by a patient (or his/her caregiver) or through a medical device to a clinician's Electronic Health Record (EHR) or a patient's Personal Health Record (PHR).

- **SDLC**

Software Development Life Cycle is the overall process of developing the software through a multi-step process from investigation of initial requirements through analysis, design, implementation and maintenance.

- **Service Level Agreements**

Service Level Agreement (SLA) is a contract between a network service provider and a customer that specifies, usually in measurable terms, what services the network service provider will furnish.

- **Service Oriented Architecture**

Service Oriented Architecture (SOA) is defined as a style resulting from the use of particular policies, practices and frameworks that deliver services that conform to certain norms. Examples include certain granularity, independence from the implementation, and standards compliance.

- **Single Sign On**

Single Sign On (SSO) is mechanism whereby a single action of user authentication and authorization can permit a user to access all computers and systems where he has access permission, without the need to enter multiple passwords. Single sign-on reduces human error, a major component of systems failure and is therefore highly desirable but difficult to implement.

- **SMART Classroom**

Smartclass is a digital initiative of Educomp, which is rapidly transforming the way teachers teach and students learn in schools with innovative and meaningful use of technology.

- **Student Information System**

A Student Information System (SIS) is a software application for education establishments to manage student data. SIS provide capabilities for entering student tests and other assessment scores through an electronic grade book, building student schedules, tracking student attendance, and managing many other student-related data needs in a school, college or university. Also known as student information management system (SIMS), student records system (SRS), student management system (SMS), campus management system (CMS) or school management system (SMS).

- **Telecare**

Includes Telehealth and Telemedicine.

- **Telehealth**

Refers to clinical services such as Electronically transfer of medical information through a telephone line and/or non-clinical services such as Distance education, meetings among telehealth networks, research and online health data management.

- **Telemedicine**  
Refers to the practice of medical care using interactive audio visual and data communications. This includes the delivery of medical care, diagnosis, consultation and treatment, as well as health education and the transfer of medical data.
- **Terabytes**  
A terabyte is a measure of data storage capacity, equivalent to one trillion, or  $10^{12}$  bytes.
- **The Millennium Development Goals**  
Millennium Development Goals (MDGs) are eight international development goals that all 192 United Nations member states and at least 23 international organizations have agreed to achieve by the year 2015. They include eradicating extreme poverty, reducing child mortality rates, fighting disease epidemics such as AIDS, and developing a global partnership for development.
- **United Nations Educational, Scientific, and Cultural Organization**  
United Nations Educational, Scientific, and Cultural Organization (UNESCO): an agency of the United Nations that sponsors programs to promote education, communication, the arts, etc.
- **United Nations Children's Fund**  
United Nations Children's Fund (UNICEF) was created by the United Nations General to provide emergency food and healthcare to children in countries that had been devastated by World War II. Headquartered in New York City, today UNICEF provides long-term humanitarian and developmental assistance to children and mothers in developing countries.
- **US General Services Administration**  
US General Services Administration (GSA) is an independent agency of the United States government, which helps manage and support the basic functioning of federal agencies. The GSA supplies products and communications for US government offices, provides transportation and office space to federal employees, and develops government-wide cost-minimizing policies, and other management tasks.
- **User Acceptance Testing**  
User Acceptance Testing (UAT) is a process to obtain confirmation that a system meets mutually agreed-upon requirements.
- **Utility Computing**  
Utility Computing is the packaging of computing resources, such as computation, storage and services, as a metered service similar to a traditional public utility (such as electricity, water, natural gas, or telephone network). This model has the advantage of a low or no initial cost to acquire computer resources; instead, computational resources are essentially rented - turning what was previously a need to purchase products (hardware, software and network bandwidth) into a service.
- **Value Added Tax**  
Value Added Tax (VAT) is levied on top of the cost of a product or service and generates revenue for a government. In India, the system of VAT has been designed to change the existing system of sales taxation. Value added tax is different from the conventional system of sales tax, because VAT is charged at every stage of value addition - whereas sales tax is imposed on final value of transaction only.
- **Virtual Learning Environment**  
A Virtual Learning Environment (VLE) is a system designed to support teaching and learning in an educational setting. A VLE will normally work over the Internet and provide a collection of tools such as those for assessment (particularly of types that can be marked automatically, such as multiple choice), communication, uploading of content, return of students' work, peer assessment, administration of student groups, collecting and organizing student grades, questionnaires, tracking tools, etc. New features in these systems include wikis, blogs, RSS and 3D virtual learning spaces.
- **Virtualization**  
Virtualization is a technique for hiding the physical characteristics of computing resources to simplify the way in which other systems, applications, or end users interact with those resources. Virtualization lets a single physical resource (such as a server, an operating system, an application, or storage device) appear as multiple logical resources; or making multiple physical resources (such as storage devices or servers) appear as a single logical resource.

- **Wide Area Network**  
Wide Area Network (WANs) is a computer network that covers a large geographical area (i.e., any network whose communications links cross metropolitan, regional, or national boundaries).
- **Y2K issue**  
The Year 2000 problem (also known as the Y2K problem, the millennium bug, the Y2K bug, or simply Y2K) was a problem for both digital and non-digital documentation and data storage situations which resulted from the practice of abbreviating a four-digit year to two digits.

## Abbreviations

- **AAR**  
Authority of Advance Rulings
- **API**  
Application Programming Interface
- **ASP**  
Application Service Provider
- **BPEL**  
Business Process Execution Language
- **CCIF**  
Cloud Computing Interoperability Forum
- **CEO**  
Chief Executive Officer
- **CFO**  
Chief Financial Officer
- **CIO**  
Chief Information Officer
- **CMS**  
Campus Management System
- **CRM**  
Customer Relationship Management
- **CSO**  
Chief Strategy Officer
- **CTO**  
Chief Technology Officer
- **DMTF**  
Distributed Management Task Force, Inc.
- **DTAA**  
Double Tax Avoidance Agreements
- **EHR**  
Electronic Health Record
- **EMA**  
Europe, Middle East and Asia
- **EMR**  
Electronic Medical Record
- **ERP**  
Enterprise Resource Planning
- **FDA**  
Food and Drug Administration
- **FISMA**  
The Federal Information Security Management Act
- **FTP**  
File Transfer Protocol
- **Gbps**  
Giga-bytes per second
- **GSA**  
US General Services Administration
- **GST**  
Goods and Service Tax
- **HIPAA**  
The Health Insurance Portability and Accountability Act of 1996
- **HIT**  
Healthcare Information Technology
- **HMIS**  
Hospital Management Information System
- **HPC**  
High Performance Computing
- **ICT**  
Information Communication Technology
- **IIT**  
Indian Institute of Technology
- **IIIT**  
Indian Institute of Information Technology
- **INR**  
Indian Rupees
- **ISV**  
Independent Software Vendors
- **IT**  
Information Technology
- **LAN**  
Local Area Network

## Abbreviations (contd.)

- **ONC**  
Office of the National Coordinator
- **PACS**  
Picture Archiving and Communication Systems
- **PC**  
Personal Computer
- **PDA**  
Personal Digital Assistance
- **PHI**  
Protected Health Information
- **PHR**  
Personal Healthcare Record
- **R&D**  
Research and Development
- **RFID**  
Radio-frequency Identification
- **RoHS**  
Restriction of Hazardous Substances
- **ROI**  
Return on Investment
- **SDLC**  
Software Development Life Cycle
- **SIS**  
Student Information System
- **SLA**  
Service Level Agreements
- **SMS**  
Student Management System
- **SME**  
Small and Medium Enterprises
- **SOA**  
Service Oriented Architecture
- **SRS**  
Student Records System
- **SSL**  
Secure Socket Layer
- **SSO**  
Single Sign On
- **TCO**  
Total Cost of Ownership
- **TLS**  
Transport Layer Security
- **UAT**  
User Acceptance Testing
- **UK**  
United Kingdom
- **UN**  
United Nations
- **UNESCO**  
United Nations Educational, Scientific and Cultural Organization
- **UNICEF**  
United Nations Children's Fund
- **USA**  
United States of America
- **USD**  
United States Dollar
- **VAT**  
Value Added Tax
- **VLE**  
Virtual Learning Environment
- **WAN**  
Wide Area Network
- **WEEE**  
The Waste Electrical and Electronic Equipment
- **WHO**  
World Health Organization





## About **KPMG in India**

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# Afterword

The dynamic and demanding business environment demands high performance from technology at optimized cost. The Cloud has the potential to transform some business ecosystems, especially those under penetrated by IT due to high capital requirements, such as Healthcare, Education and the Government.

These sectors are expected to witness a paradigm shift as they adopt the Cloud and leverage technology. This would not only improve the sectors but also impact large sections of society. The Cloud is expected to enable both private and public services to be delivered more rapidly and transparently to a larger audience.

However, there are certain challenges such as security, privacy of data, disaster recovery, etc. that would need to be addressed before the Cloud becomes the utility it has been envisioned to be. Moreover, some resistance to change is also expected from the existing IT ecosystems as IT professionals would be required to adapt to the new paradigm.

Early adopters of the Cloud have become more nimble and efficient and are beginning to show a competitive edge from embracing the Cloud. These organizations could be case examples for others, who can learn from these experiences. They would therefore be able to carefully plan their Cloud strategy after evaluating various business and technical factors.

As we embark on a new decade the Cloud could become the next revolutionary wave. The scalability and elastic nature of the Cloud holds promise to organizations to not just alter the way they manage IT but also transform businesses. The Cloud could, therefore, be a call for organizations to take a leap of faith, after completing their due diligence. In times to come we could see the harvesting of a new world in the Cloud Reign!

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