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Cloud Computing - Challenges & Opportunities

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Cloud computing, from becoming a significant technology trend in 2009, there is a wide spread consensus amongst industry observers that it is ready for noticeable deployment in 2010 and is expected to reshape IT processes and IT marketplaces in the next 3 years.

2. So, what is cloud computing? Like most evolving technologies, in the initial phases, opinions differ. As per Wikipedia, cloud computing describes a new supplement, consumption and delivery model for IT services based on Internet, and it typically involves the provision of dynamically scalable and often virtualized resources as a service over the Internet. Definitions given by NIST and Gartner also encompass the key five cloud characteristics, viz. On-demand service, Broad network access, Resource pooling (location pooling), Scalable & elastic and Metered services.

3. Foundation elements of cloud computing comprise of, interalia, primary technologies, such as Virtualization, Grid computing, Service oriented architectures, Distributed computing, Broadband networks, Browser as a platform, Free & Open source software and other technologies such as Autonomic systems, Web 2.0, Web application framework and Service level agreements. Therefore, it would not be an exaggeration to say that cloud computing is a next natural step of integration of current diverse technologies & applications.

4. Services provided by cloud computing can be broadly grouped into three major categories:

* Software-as-a-Service (SaaS) comprises end-user applications delivered as a service, rather than a traditional, on-premises software. SaaS has the broadest market. Examples – salesforce.com.

* Platform-as-a-Service (PaaS) provides an independent platform or middleware as a service on which developers can build and deploy customer application. Common solutions provided in this tier range from APIs and tools to database and business process management system, to security integration, allowing developers to build applications and run them on the infrastructure that cloud vendors owns and maintains. Examples - Microsoft windows azure platforms services, Google apps.

* Infrastructure-as-a-Service (IaaS) primarily compasses the hardware and technology for computing power, storage, operating systems or other infrastructure, delivered as off-premises, on-demand services rather than dedicated as on-site resources. Because

customers can pay for exactly the amount of service they use, like for electricity or water, this service is also called utility computing. Examples – Amazon elastic compute cloud (Amazon EC 2) or Amazon simple storage service (Amazon S 3), Eucalyptus open-source cloud computing system.

5. Generally, there are four cloud deployment models;

* Private (cloud enterprise owned or leased)

* Community cloud (shared infrastructure for specific community)

* Public cloud (sold to public/any user, large scale infrastructure)

* Hybrid cloud (composition of two or more models)

6. Possible effects of cloud computing include amongst others:

* Small enterprises use public SaaS and public clouds and minimise growth of data centres

* Large enterprise data centres may evolve to act as private clouds

*Large enterprises may also use hybrid cloud infrastructure software to leverage both internal and public clouds

*Public cloud may adopt standards in order to run workloads from competing hybrid cloud infrastructure

Global Initiatives to Tackle Challenges Ahead:

7. Possible benefits arising out of adopting/migrating to cloud computing models have been recently well documented in literature and therefore these are not reproduced here. However, for cloud computing to realise its full potential and become mainstream member of IT portfolio & choices, a lot of challenges are required to be tackled related to privacy & security and associated regulations compliance, vendor lock-in & standards, interoperability, latency, performance & reliability concerns.

8. In fact, if flurries of cloud computing initiatives globally in 2009 are any indication, 2010 and the next couple of years are likely to see solutions to most of the concerns/risks. Some illustrative examples are as follows:

8.1 National Institute of Standard and Technology (NIST), USA has initiated activities to promote standards for cloud computing.

8.2 To address the challenges of cloud computing interoperability, several standards groups and industry consortia are developing specifications and best practices to enable cloud interoperability. Notable amongst them being, Open Cloud Consortium(OCC) of Distributed Management Task Force(DMTF) for cloud interoperability standards, Cloud Security Alliance

working on recommendations for best practices regarding cloud computing security, Open Group Cloud Working Group for security and identity management.

8.3 On April 23, 2009, National Science Foundation(NSF), USA announced $ 5 million grants to 14 leading US universities through its Cluster Exploratory (CLuE) programme to participate in the IBM/Google Cloud Computing University Initiative.

8.4 In September 2009, US Government announced its first cloud-computing project, Apps.gov, to lower the cost of government operations while driving innovation within the government. Apps.gov is starting small – with the goal of rapidly scaling up in size. Along the way, Apps.gov will need to address various issues related to security, privacy (compliance to FISMA and Privacy Act of US), information management and procurement to expand their cloud computing services.

8.5 On October 20,2009, EuroCloud, a European network of local SaaS and cloud computing communities from different countries including vendors and industry experts with the aim to develop next generation of added value applications. IBM and European Union have also launched joint research initiative for cloud computing.

8.6 On January 13, 2010, HP and Microsoft announced an agreement to invest $ 250 million over the next three years to significantly simplify technology environments via cloud computing. The two companies will collaborate on an engineering roadmap for converged application platforms, comprehensive virtualization solutions and integrated management offerings to advance cloud computing.

Way Forward for Us:

9. India is globally known for its strengths in innovation in IT services & associated models and cloud computing is an emerging opportunity in this space. It is understood that TCS, Infosys and Wipro amongst others are taking steps towards making cloud-based services available to their customers. As brought-out in paras 7 & 8 above, to realise the full potential of cloud computing, a lot of challenges are required to be tackled primarily related to privacy, security, standards, interoperability, latency, performance and reliability concerns besides supporting R&D and creating specific test beds in public-private partnership -- call it a ***National Cloud Computing Initiative*** or any other name with clear deliverable & collaboration with international initiative, and also further enhancing scientific & technological knowledge on all related foundation elements of cloud computing.