Architectural Strategies for Green Cloud Computing:
Environments, Infrastructure and Resources

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ABSTRACT

Opportunities for improving IT efficiency and performance through centralization of resources have increased dramatically in the past few years with the maturation of technologies, such as service oriented architecture, virtualization, grid computing, and management automation. A natural outcome of this is what has become increasingly referred to as cloud computing, where a consumer of computational capabilities sets up or makes use of computing in the cloud network in a self service manner. Cloud computing is evolving, and enterprises are setting up cloud-like, centralized shared infrastructures with automated capacity adjustment that internal departmental customers utilize in a self service manner. Cloud computing promises to speed application deployment, increase innovation, and lower costs all while increasing business agility. This paper discusses the various architectural strategies for clean and green cloud computing. It suggests a variety of ways to take advantage of cloud applications and help identify key issues to figure out the best approach for research and business.

Keywords: Architectural Strategies, Cloud Computing, Cloud Environments, Cloud Infrastructure, Cloud Resources, Education Cloud, Green Computing, Java EE, Open Source Cloud

INTRODUCTION

Today is the age of information technology. The facets of work and personal life are moving towards the concept of availability of everything online. Significant technological advances are often made during periods of crisis and change. Thus it is unsurprising that today's CIO's and IT professionals, confronted with extraordinary challenges of spiking energy bills, underutilized data centers, accelerated data growth, during a time of restricted capital and economic uncertainty are gravitating towards innovative efficiency enhancing technological models (http://www.cioforum.com/; http://www.cio.in/). Cloud computing is one such model. Cloud computing is the latest evolution of Internet-based computing (Marks & Lozano, 2010). The Internet provided a common infrastructure for applications. It deploys as a complete platform for supporting scalable applications in a way that improves the efficiency of both IT management

and operations. The architectures used by true cloud computing platforms - rapid scalability, flexibility, resource pooling and usage-based pricing - are significantly different from what are now deemed "classic" IT computing models. With these differences comes the opportunity for significant gains in asset efficiency, capital utilization and business responsiveness (Sasikala, in press). The potential benefits of cloud computing are overwhelming. However, attaining these benefits requires that each aspect of the cloud platform support the key design principles of the cloud model. One of the core design principles is dynamic scalability, or the ability to provision and decommission servers on demand (http://cloudcomputing.qrimp. com/portal.aspx) Unfortunately, the majority of today's database servers are incapable of satisfying this requirement. Cloud computing is not a fad it is driven by some tangible and very powerful benefits. Whether the cloud is provided as an internal corporate resource, as a service hosted by a third-party, or as a hybrid of these two models, there are some very real advantages to this model (http://www.gartner. com). These advantages derive from specialization and economies of scale. The combination of all the benefits is driving cloud computing from mere buzzword to disruptive and transformational tsunami. The report from IDC says that due to the emergence of cloud computing, IT marketplace is undergoing a change and it expects that investment on cloud services will reach to $42 billion by 2012 (Wagner, 2010).

Goldman Sachs, Wells Fargo Securities, Gartner and other prominent observers of the technology industry predict that cloud computing is the most significant IT shift of this decade (http://cloudcomputing.qrimp.com/portal.aspx; http://www.gartner.com). SYS-CON's Cloud Computing Journal lists the top 150 most active players in the cloud ecosystem (Geelan, 2009). A robust ecosystem of solutions providers is emerging around cloud computing. In this paper we discuss the various feasible applications of the latest Java Enterprise Edition platform and the potential roles of web profiles in the present context along with multi-cloud framework

approach. The paper also elucidates cloud databases and suggests on preparing data for cloud within the limits of CAP theorem. The paper highlights the open source private cloud computing benefits mainly of the Eucalyptus. Cloud computing scenario in India in general and for the small and medium enterprises are also discussed. Finally, cloud applications in education and the resources available are explained in detail.

JAVA™ PLATFORM APPLICATIONS IN CLOUD COMPUTING

The evolution in Sun's enterprise Java™ platform, Java EE (Enterprise Edition), over the years lead to a remarkable transformation for a mature, widely deployed, well supported server side development platform (http://in.sun.com/java/). The focus of Java EE 5 was squarely on reducing complexity by embracing the concepts of annotations, POJO programming, zero configuration systems and freedom from XML hell. One of the major criticisms of Java EE has been that it is simply too large. They have grown in complexity and size, leading to very large downloads and very large runtimes. In majority of cases, the full EE environment just isn't needed. Indeed, a majority of small to medium range Java web applications do not utilize the full Java EE stack. One can imagine the same to be true of SOA applications that would use features like messaging, transactions, persistence, and web services but have no need for presentation tier technologies like JSP or JSF. Profiles are designed to address this issue. In recognition of this, most of the well known application servers have released "lite" versions of themselves. Java EE 6 is a big step in the journey towards the ideal of a simple, streamlined and well integrated platform (http://www.oracle.com/technetwork/java/javaee/tech/index.html). Java EE 6 is the industry standard platform for building enterprise-class computing applications coded in the Java programming language. Based on

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