Cloud Computing

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Moving into 2013, cloud computing remains a big IT trend. Although *IT Professional* has previously published two special issues on this topic (September/October 2010 and January/February 2012), it's clear that readership interest remains high. In 2011, 10 of the top-25 downloaded articles from IEEE's Xplore portal for *IT Professional* were on cloud computing.

What's not clear is how many people actually know what cloud computing is in the more formal sense. Some people believe that clouds are simply large databases; others think clouds are email servers. Both are partially true. And some think of this technology as coming from actual clouds:

> A recent survey of 1,000 Americans [conducted] by Wakefield Research for Citrix … found that 51 percent of respondents believe that stormy weather can interfere with cloud computing. A plurality of respondents (29 percent) also think that the cloud is an actual cloud. A paltry 16 percent actually knew what the cloud was.[1]

Cloud computing allows for pay-per-use or charge-per-use access to applications, software development and deployment environments, and computing infrastructure. It provides optimized and efficient computing through enhanced collaboration, agility, scalability, and availability. The number of personal cloud users is growing at a remarkable pace. However, as the change in technology is often seemingly for the user (especially software as a service), many people don't even realize they're cloud participants. It's important for people to have an understanding of the technology that underlies cloud computing, as this will help them use a larger variety of cloud services and improve their work lives, personal lives, and the balance between them.

The Cloud Revolution

When did the cloud revolution begin? Many articles include timelines for the various computing advances that led to clouds.[2,3] Not all technology historians agree on what deserves the lion's share of credit for this new computing paradigm, but most agree that virtualization, developed just as organizations with excess computing capacity wished to lease it out, was a big contributor. At the same time, increases in Internet bandwidth supported the economic argument in favor of such "rental" computing.

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This then offered a solution to the decades-long challenges IT enterprises faced—rising IT costs, the constant need for capital investments, server sprawl, and ballooning energy costs and demands. It also helped address increasing system complexity that required specialized talent for maintenance and support; varying resource usage; a growing demand for business-process simplification; and increased time-to-market pressures.

With the enormous effort organizations around the world have exerted during the past few years to address these challenges, cloud computing has revolutionized how governments operate and how companies do business. Governments are now leveraging the cloud for its flexibility, operational benefits, and substantial cost savings. For example, in May 2009, the Japanese government announced the Kasumigaseki Cloud; in September 2009, the US government launched the Cloud Computing Mall; and in January 2010, the UK government introduced the G-Cloud government cloud infrastructure. Successful businesses—which are currently migrating services to the cloud and relying on it to help manage hardware and software—will soon have no headquarters or IT infrastructure.

Cloud computing has also infiltrated people's daily lives. The commoditization of computing services is now a reality, and such services are increasingly delivered by an infrastructure that's ever-present but hiding many of the technical details. Individual's lives are affected by free email servers, applications, and storage capabilities—all accessible anytime, through any device, and from anywhere.

Cloud computing is thus no longer on the horizon; it has become the next logical step for the IT industry. It's the new strategic weapon in enterprise computing and the new norm in every sector of society. Businesses, educational institutions, governments, community organizations, and individuals are looking at cloud offerings to be able to focus on managing information instead of infrastructure. Moving applications and storage capabilities, application development environments, and even infrastructure and security capabilities to the cloud offers more efficient use of IT hardware and software investments, on-demand provisioning (and deprovisioning), elastic scalability, agility, and usage-based charging.

Cloud computing demand is further driven by the explosive growth of data and the need for this data to be securely stored yet accessible from anywhere, anytime. Unprecedented data availability has been triggering numerous new value-added services, which in turn have created more data and data services. As a result, near-future developments will focus on cloud security standards, data virtualization through advanced analytics and parallel-processing optimization, mobile applications, and platform as a service for specialized mobile platforms.

In this Issue

We're pleased to introduce the four theme articles, which share some recent cloud computing experiences related to energy-efficiency enhancement, security, and migration performance.

In "Solar-Powered Cloud Computing Datacenters," Laura Hosman and Bruce Baikie examine three existing approaches to building datacenters: low-power computing platforms, energy-aware cloud computing, and direct-current power distribution. They conclude that a seamless integration of the three approaches will lead to an energy-efficient green cloud computing datacenter.

In "The Insecurity of Cloud Utility Models," Joseph Idziorek, Mark F. Tannian, and Doug Jacobson reveal, from a case study, an often-neglected vulnerability of cloud utility models to Fraudulent Resource Consumption (FRC) attacks, where consuming the bandwidth of Web-based services causes a financial burden on cloud consumers. They conclude that utility models should be restructured to address this vulnerability.

In "Energy-Efficient Virtual Machine Consolidation," Pablo Graubner, Matthias Schmidt, and Bernd Freisleben propose a virtual machine consolidation method aiming for saving energy in infrastructure-as-a-service cloud computing environments. Eucalyptus-based implementation is presented as a proof of concept.

In the final theme article, "Using Model Checking to Evaluate Live Migrations," Shinji Kikuchi and Yasuhide Matsumoto propose leveraging a probabilistic model-checking approach to quantitatively evaluate the performance and behaviors of live-migration operations during server virtualization.

For IT professionals in the cloud computing area, it's important to think of where cloud computing is going and what the challenges are for 2013. Some more focused topics include cloud computing architectures and cloud solution design patterns; infrastructure, platform, application, business, social, and mobile clouds; big data analytics clouds; autonomic business process and workflow management in clouds; and innovative cloud applications and experiences.

We hope this issue is as much fun for you to read as it was for us to pull together. Don't hesitate to contact us with any questions or feedback.

References

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