

# The Limits of Public Clouds for Business Applications

—An overly simplistic reliance on the utility model risks blinding us to the real opportunities and challenges of cloud computing

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## **Abstract**

Descriptions of cloud computing often emphasize the silver lining more than the chances of getting wet. Utility computing offers many benefits, but will the cloud — especially the public cloud — lead to the extinction of CIOs because IT will be consumed as simply as electricity? No doubt, cloud computing is a breakthrough technology that will continue to unleash new innovations and bring new efficiencies and advantages to business. It removes infrastructure and capital expense as a barrier to entry and allows startups to scale up cheaply and rapidly.

On the other hand, enterprises face limitations in using the cloud for high-performance and mission-critical applications such as ERP. Unfortunately, the cloud's limits are often obscured by all the hype. It's time to stop looking at the cloud as a panacea. This presentation seeks to clear up some misperceptions and help people make better choices.

## **1. The Sunny Side of the Cloud**

Certainly, cloud computing offers many attractive benefits to enterprises. The cloud model moves IT infrastructure from an upfront capital expense to an operational one. Companies can use the cloud for large batch-oriented tasks — those involving large spikes in requirements for processing power — that otherwise would be out of reach or require huge investment. Many enterprises provision computing resources for peak loads, which often exceed average use by a factor of 2 to 10. Consequently, server utilization in datacenters is often as low as 5 to 20 percent. One key benefit of cloud computing is that it spares companies from having to pay for these underutilized resources. Cloud computing shifts the IT burden and associated risks to the vendor, who can spread variations over many customers. Organizations can use the cloud to rapidly scale up or down; they can also buy or release IT resources as needed on a pay-as-you-go model. As one group of researchers from the University of California, Berkeley noted, “This elasticity of resources, without paying a premium for large scale, is unprecedented in the history of IT” ([www.eecs.berkeley.edu/Pubs/TechRpts/2009/EECS-2009-28.pdf](http://www.eecs.berkeley.edu/Pubs/TechRpts/2009/EECS-2009-28.pdf)).

## **2. Plug and Play?**

Cloud proponents often compare utility computing to electrical utilities. One of the most prominent voices behind this argument is Nicholas Carr, author of *The Big Switch: Rewiring the World, from Edison to Google* (Norton, 2008). Carr hails utility computing as a historic shift similar to the advent of electrical utilities. This utility analogy has taken hold in the public imagination. Although useful, this analogy isn't entirely accurate because it blinds us to the cloud's limitations for enterprises. The reality is that cloud computing simply can't achieve the same plug-and-play simplicity as electricity.

### **3. The Trade-Offs of the Cloud**

Enterprises can expect to face many trade-offs when they move IT into the cloud.

#### ***Security***

Security is one of the biggest challenges to the cloud model, and it's often an emotional one as well. Behind the firewall, enterprises have control of their data. In the cloud, they must trust the provider. For organizations whose existence depends upon safeguarding customer data, trade secrets, classified information, or proprietary information, public cloud providers don't offer sufficient protection. Most providers find it hard, if not impossible, to meet standards for auditability and comply with legislation such as Sarbanes-Oxley and the Health and Human Services Health Insurance Portability and Accountability Act (HIPAA).

#### ***Interoperability and Lock-In***

As cloud offerings proliferate, there will be ongoing challenges with interoperability, portability, and migration. In an on-premise model, enterprises control their infrastructure and platforms at any time. In the cloud, they're locked in to a provider and no longer control their own IT. Cloud providers speak different languages. All the major providers offer unique, and often proprietary, data storage (for example, Google's BigTable, Amazon's Dynamo, and Facebook's Cassandra). Scalable data storage isn't yet a commodity and is unlikely to be so for a long time due to the fact that there is no simple generic solution for distributed data storage.

#### ***Absence of Service-Level Agreements***

Another problem is the lack of well-defined (SLAs) by cloud providers. What's the guaranteed uptime? What are the repercussions if the provider fails to meet these standards? What happens to customer data if the company moves to a different provider? Cloud providers offer precious few protections to enterprises that trust all their IT to the cloud.

#### ***Performance Instability***

The cloud is often touted as a solution for organizations with large variations in computing demands. Less well known is the performance variability in the clouds themselves. Researchers in Australia conducted stress tests to demonstrate that Amazon, Google, and Microsoft suffered from variations in performance and availability due to loads. ([www.itnews.com.au/News/153451,stress-tests-rain-on-amazons-cloud.aspx](http://www.itnews.com.au/News/153451,stress-tests-rain-on-amazons-cloud.aspx)). Another example for the limitations of performance predictability is research by Kossmann et al. (D. Kossmann, T. Kraska, and S. Loesing, "An Evaluation of Alternative

Architectures for Transaction Processing in the Cloud,” Proc. SIGMOD Conf., 2010, pp. 579–590). They showed that cloud providers don’t yet deliver electricity-like performance.

### ***Latency and Network Limits***

As long as we rely on fiber-optic cables, we’re limited by network speed (unfortunately, the speed of light isn’t amenable to the kind of speed improvements associated with Moore’s law). As applications make ever-more intense use of large volumes of data, data transfer poses an increasing bottleneck. For example, University of California, Berkeley, computer scientists calculated the costs of shipping 10 Tbytes of data from the Bay Area to Amazon in Seattle. Given the average bandwidth, sending this data would take 45 days and cost US\$1,000 in network transfer fees. In contrast, shipping 10 1-Tbyte disks overnight would cost only \$400.

### ***No Scalable Storage***

Cloud computing isn’t simply a matter of adding an infinite number of servers. Some problems and processes can’t be solved simply by adding more nodes — they require different architectures of processing, memory, and storage. Most business applications today rely on consistent transactions supported by RDBMSs, which unfortunately do not scale. The cloud lacks scalable storage with an API as rich as SQL.

### ***Stifling Innovation?***

Perhaps the cloud’s biggest limitation is that it might impair innovation. Implemented properly, ERP represents a significant source of competitive advantage, but if ERP becomes a commodity — the cloud model’s central premise — it limits a company’s ability to innovate. IT represents a source of competitive advantage for many organizations. In a 2008 Harvard Business Review article ([www.scribd.com/doc/13415798/Investing-in-IT-That-Makes-a-Competitive-Difference](http://www.scribd.com/doc/13415798/Investing-in-IT-That-Makes-a-Competitive-Difference)), Andrew McAfee and Erik Brynjolfsson found that competition within the US economy had accelerated to unprecedented levels in the wake of the mainstream adoption of the Internet and commercial enterprise software. The main catalyst was the massive increase in IT power. As the authors write, “a company’s unique business processes can now be propagated with much higher fidelity across the organization by embedding it in enterprise information technology. As a result, an innovator with a better way of doing things can scale up with unprecedented speed to dominate an industry.” Real IT innovation comes from tailoring ERP systems to the unique needs of every company. Cloud providers offer the smallest common denominator limiting the ability of customers to tailor their software and wringing real competitive advantage from their IT systems. Consider Apple. Its shift from a perpetual license model to the iTunes store’s pay-per-use option allowed it to quadruple revenues in four years. The Apple model depends on tight integration between Apple’s ERP system and the billing engine, which handles 10 million sales per day. It would be difficult, if not impossible, to set up such a tight integration between the cloud’s ERP and Apple’s highly proprietary billing software.

