Cloud Computing: Benefits and Risks of Moving Federal IT into the Cloud

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Chairman Towns and Chairwoman Watson, Ranking Member Issa and Ranking Member Bilbray, Members of the Committee, thank you for holding this hearing on cloud computing and for inviting me to share my views with you. Cloud computing is a revolutionary and disruptive new technology that is having a profound impact on how we use, manage and build computing applications. As the Senior Vice President for Global Public Policy at Salesforce.com, I am deeply involved in government discussions about cloud computing, and I applaud the efforts of this Committee and the Administration to enable federal agencies to take advantage it.

About Salesforce.com

Salesforce.com is a leading enterprise cloud computing company that provides cloud solutions to organizations of all sizes in all industries globally. Our main service offerings are applications that allow organizations to input, store, process, and access data to manage their sales and customer services. In addition, we provide a platform (Force.com) that enables customers and developers to build and sell new cloud applications, as well as a collaboration tool (Chatter).

Salesforce.com delivers its services over the Internet through commercially available Web connections and browser software. Instead of building and maintaining costly IT infrastructure, our customers simply log on to the Salesforce.com Website and access their cloud services using a unique username and password. Over 77,000 organizations globally, including governments and businesses in highly regulated industries like financial services, healthcare, insurance and communications trust Salesforce.com with their data. Our U.S. federal government customers include the Bureau of Census, the Department of Army, the Department of Energy, the Department of Health and Human Services, the Department of Homeland Security, the Department of Navy, the Department of State, the Department of Transportation, the Environmental Protection Agency, the General Services Administration and NASA, among others.

In my remarks today, I will discuss the core characteristics of cloud computing. I will also address issues related to cost, data ownership, security and interoperability because I understand that they are of particular interest to the Committee. In doing so, I will make reference the Salesforce.com enterprise cloud computing model, not the consumer cloud computing model that companies like Amazon and eBay offer.

How do you know cloud computing when you see it?

Descriptions of cloud computing are like the parable of the blind men and the elephant. Six blind men were asked to touch an elephant and describe it. One blind man grasped the elephant's trunk and announced that it resembled a giant snake; another felt the legs and said it was more like a tree; a third touched the tusks and insisted that it was similar to an enormous walrus; and so on. While each was correct in his own narrow description, each missed the larger picture.

This parable will sound familiar to anyone who has followed the discussion about cloud computing. Some focus on the fact that cloud computing involves third-party data centers and insist that because they hold their customer's data in remote data centers they are cloud computing providers; others emphasize the pay-as-you-go feature and conclude that because they charge their customers in increments over time they are cloud providers; others stress that it is accessed over IT networks and claim that because they provide applications over networks they are cloud providers.

While each of these descriptions is true as far as it goes, by themselves they do not constitute cloud computing. Nor are the companies that provide these discrete functions cloud computing providers any more than an elephant is a snake, a tree, or a walrus.

Cloud computing consists of a combination of these three features, plus something known as "multi-tenant" architecture.

- Third-party data centers – With cloud computing the actual computing takes place in a third-party data center, not on an individual's computer or within a company's own IT facilities. As a result, the user does not have to install or maintain a local copy of the software, invest in IT infrastructure, or maintain data centers.

- Internet Access – Users access cloud software over the public Internet with a browser. This means that they can retrieve their data and applications anywhere they have Internet access without dedicated networks or proprietary communication lines. It also means they can access information from multiple devices, like lap-top computers and smart-phones.

- Pay-as-you-go – Enterprise cloud customers do not purchase cloud applications, but subscribe to them, usually on a per-seat or a per-usage basis for a period of time.

Multi-tenancy

As important these three features are, unless they are combined with a multi-tenant architecture, they do not constitute true cloud computing

NIST alludes to the essential requirement of multi-tenancy in its definition of cloud computing, which reads as follows:

> *Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.*

The definitive reference to multi-tenancy comes when NIST defines resource pooling:

> *The provider's computing resources are pooled to serve multiple consumers* ***using a multi-tenant model,*** [emphasis added] *with different physical and virtual resources dynamically assigned and reassigned according to consumer demand.*

At the September 2009 Gov 2.0 Summit in Washington, DC Casey Coleman (CIO of GSA and Chair of the Federal Cloud Computing Executive Steering Committee) summed up the essential role of multi-tenancy when she stated that "Cloud computing by its very nature is multi-tenant."

A good analogy for multi-tenancy is the skyscraper. A skyscraper enables large numbers of different tenants to conduct their operations in the same building. The tenants do not have to lay the foundation, construct the building or maintain the underlying infrastructure. Instead, they simply lease office space and customize it to meet their needs, knowing that their business activities will be kept private from the other building occupants. The landlord is responsible for improvements to the building, and each time he upgrades the infrastructure all of the tenants benefit. If a tenant's needs change or if it becomes dissatisfied with the building services, he can terminate his lease and move.

Just like a skyscraper allows many different occupants to run their businesses discretely within a single building, a multi-tenant cloud computing platform allows many different users to run their computer applications discretely on the same computing platform. Because the users' data and applications are separated logically within the hardware and software, they can view only the data and cloud services that pertain to them. In this respect, multi-tenant cloud architecture is like online banking – it allows a number of consumers to use their individual accounts at the same time while keeping their banking information private through the logical (not physical) separation of data.

In order to appreciate the power of multi-tenant cloud computing, it is useful to compare it to traditional, single-tenant computing applications. Multi-tenant applications can satisfy the needs of numerous organizations with the hardware resources and staff needed to manage one large computing stack. By contrast, single-tenant applications require a dedicated set of resources for each organization. It is largely for this reason that the Application Service Provider (ASP) single-tenant computing model of the late 1990s failed. In the ASP model, the setup, maintenance and upgrades of computer applications were outsourced to a third-party service provider, just like they are with cloud computing. The difference was that the ASP had to maintain a separate infrastructure stack for each customer. As more and more customers were added, the sheer scale, cost and complexity of maintaining the aggregate computing infrastructure became unsustainable.

With multi-tenant cloud computing, the software applications are provided as a service to multiple customers on a single, large infrastructure stack. The configurations of each user are stored as metadata that describes the base functionality of their application and corresponds to their data and customizations. This metadata is then interpreted by the platform's runtime engine. In a robust multi-tenant, metadata cloud architecture there is a clear separation of the compiled runtime engine (kernel) and the application data. As a result, the kernel can be upgraded without disrupting customer's applications or data, thus

allowing for continuous improvement in performance, reliability, security and scale. In short, multi-tenant computing yields massive cost, speed, scale and innovation advantages that single-tenant computing cannot match.

With its multi-tenant architecture, Salesforce.com is able to run approximately 230,000 applications for its more than 77,000 customers on just a few thousand servers. No other computing model delivers that kind of efficiency. A single-tenant computing model (sometimes referred to as a "private cloud") would require a minimum of 2 servers per application (one database server and one application server), plus additional servers for redundancy and disaster recovery. Consequently, a single-tenant computing model could require several hundred thousand servers to manage the computing needs of the customer base that Salesforce.com manages with just a few thousand servers.

The key advantages of the Salesforce.com multi-tenant enterprise cloud computing solutions include the following:

- *Secure, scalable and reliable delivery platform* – The delivery platform for our service has been designed to provide our customers with high levels of performance, reliability and security. We have built, and continue to invest in, a comprehensive security infrastructure, including firewalls, intrusion detection systems and encryption for transmissions over the Internet, which we monitor and test on a regular basis.
- *Rapid deployment* – Our service can be deployed rapidly since our customers do not have to spend time procuring, installing or maintaining the servers, storage, networking equipment, security products, or other infrastructure hardware and software necessary to ensure a scalable and reliable service.
- *Ease of integration* – Our platform is designed to enable IT professional to integrate our service with existing applications quickly and seamlessly. Our Force.com platform provides a set of application programming interfaces (APIs) that enable customers and independent developers both to integrate our service with existing third-party, customer and legacy applications, and to write their own application services that integrate with our service.
- *Rapid development of applications using the Force.com platform* – Our customers and third party developers can develop applications rapidly because of the ease of use and the benefits of a multi-tenant platform.
- *Lower total cost of ownership* – We enable customers to achieve significant upfront savings relative to their traditional enterprise software model. Customers benefit from the predictability of their future costs since they pay for the service on a per subscriber basis for the term of the subscription contract. All upgrades are included in our service, so customers are not burdened or disrupted by the periodic need to perform system upgrades. Because we implement all upgrades on our servers, new features and functionality automatically become part of our service on the release date and therefore benefit all of our customers immediately.
- *Increasing innovation* – By providing infrastructure and development environments on demand, we provide developers the opportunity to create new and innovative applications without having to invest in hardware and distribution. A developer with an idea for a new application can log onto our platform, develop,

host and support their system on Force.com, and make the application accessible for a fee to our customers.

- *High level of user adoption* – We have designed our service to be intuitive and easy to use. Since our service contains many tools and features recognizable to users of popular websites such as those of Amazon, eBay and Google, it has a more familiar user interface than typical enterprise customer relationship management (CRM) applications. As a result, our users do not require substantial training on how to use and befit from our service.

For the U.S. government, these advantages translate into cost savings, flexibility, fast deployment and lower risk of project failure. Traditional government IT systems require significant up-front investments in hardware and software. Moreover, they can often take years to write, customize and install. As a result, they frequently fail to deliver the required functionality and are out-of-date by the time they are deployed, leading to newspaper articles about unsuccessful government IT projects with massive cost over-runs. Because cloud computing eliminates large up-front capital investments, lets government agencies start with a few users to see if the application meets their requirements and enables them to scale rapidly if it does, there is much less chance of waste and failure.

Like any new technology, cloud computing raises several issues that must be addressed if it is to achieve its promise. Among these are cost, data ownership, vendor lock-in, security and interoperability. I will discuss each of these below. In doing so, I will refer to the experience of Salesforce.com as an enterprise cloud computing provider and our customer case studies.

Cost

Because cloud computing services can be tailored to the specific needs of individual customers, it can be difficult to calculate precise cost comparisons between cloud solutions and traditional on-premise solutions. Nonetheless, most studies conclude that cloud computing offers substantial cost savings over on-premise computing. Moreover, there is broad consensus that cloud computing is far less risky than traditional on-premise computing – there are no massive up-front costs because users do not have to purchase software licenses or invest in expensive IT infrastructure. There is also general agreement that the on-going cost of cloud computing is much more predictable than traditional on-premise computing. Users of the cloud typically pay as they go, and pay only for what they use.

One of the best studies of the cost savings of cloud computing to the U.S. government is by Darrell West, Saving Money Through Cloud Computing (Brookings Institute, May 2010). This report concludes that there are significant cost savings associated with cloud computing.

> *Depending on the scope and timing of the migration, reliance on public versus private clouds, the need for privacy and security, the number of file servers before*

> *and after migration, the extent of labor savings, and file server storage utilization rates, savings generally average between 25 and 50 percent. Combined with cross-platform accessibility, scalability, and reliability, there is a strong argument for the federal government to place a greater emphasis on cloud solutions. Clouds bring convenience, efficiency, and connectability that are vital to government agencies.*

Because of these cost savings, Dr. West concludes that the amount of federal IT spending devoted to cloud computing will grow rapidly.

Salesforce.com case studies of government cloud implementations support these conclusions. For example, the U.S. State Department's Nonproliferation and Disarmament Fund (NDF) used Salesforce.com to create a cloud application to give program managers around the world ready access to up-to-date budget information. A 2009 Nucleus Research report estimated that the NDF cloud application cost one-quarter as much as it would have if it had been developed in-house. Furthermore, the report concluded that the return on investment was 216%, the payback time was 8 months, and the average annual benefit was $1,625,066.

NJ TRANSIT, which uses Salesforce.com to track and respond to service issues, offers a similar success story. Because of the communication and issue-tracking capabilities the cloud application enabled, NJ TRANSIT has been able to increase the number of inquiries it handles by 600% and reduce its response time by 35% without adding any additional staff.

These U.S. public sector examples are backed-up by case studies from the private sector and from other governments. For example, the Salesforce.com cloud-computing model saved Qualcomm an estimated $100,000 in hardware costs and allowed it to reduce support staff by 60%. Similarly, the Japan Post Network avoided $10 million hardware and software costs by deploying a Salesforce.com cloud solution and experienced a return in investment of 511% over three years. All of these case studies can be found on the Salesforce.com Website at www.salesforce.com.

Data Ownership, Compliance and Vendor Lock-in

As an enterprise cloud computing company, Salesforce.com manages massive amounts of information -- about 300 million transactions each business day. We use and process the information our customers enter into our system only as they instruct us to, or in order to fulfill our contractual and legal obligations. We claim no ownership rights to the information our customers submit to our cloud computing services. We disclose information submitted by our customers only if required to do so by law, and we provide affected customers prior notice of any such compelled disclosure to the extent permitted by law.

Salesforce.com also maintains strict confidentiality obligations and does not access customer data except under narrowly-defined circumstances. Like any organization that

stores and processes data, we face a patchwork of U.S. state, federal, and international privacy requirements. Customer data may also be subject to these requirements.

Some critics have raised concerns that cloud computing will lead to vendor lock-in. It is unclear, however, that customers will be locked-into their cloud computing applications any more than they are to their traditional on-premise computing applications. At Salesforce.com, for example, if a customer decides that they no longer want to use our cloud services, we make their respective information available to them in a format that allows them to download it and take it elsewhere.

Security

Security concerns are often cited as one of the main reasons to avoid cloud computing. Critics of cloud security emphasize that cloud computing is a new technology that lacks appropriate security standards and adequate controls. They also voice reservations about multi-tenant architecture and often point to private clouds as the best way to address the security issues associated with cloud computing. Others, however, believe that enterprise cloud computing is more secure than traditional client-server computing. They note that enterprise cloud computing allows for uniform high performance for all users, continuous improvements in the security of the underlying platform, features that can be tuned to match the sensitivity of the data being stored, a locked-down management network that is easier to secure than a distributed corporate network, and robust back-up systems.

In assessing the security of cloud computing platforms, it is important to look beyond generalizations to the specific security practices of individual cloud providers. Broad assertions about cloud security are like saying that trucks are safer than cars. Such a statement may appear to be true in the abstract, but it does not take into account the make, model and performance of the vehicles, where they will be driven, or who the driver is. Similarly, declarations like "private clouds are more secure than public clouds" are not very meaningful unless the security features of individual private and public cloud providers are carefully evaluated.

Salesforce.com views security as part of a trust equation that includes privacy, performance and reliability. Because trust also requires transparency, we have established a public trust site (https://trust.salesforce.com) that provides the Salesforce.com community with real-time information on system performance and security, including the following:

- Live and historical data on system performance
- Up-to-the minute information on planned maintenance
- Phishing, malicious software, and social engineering threats
- Best security practices for your organization
- Information on how we safeguard your data

The Salesforce.com security management system is based on an internationally accepted security framework that encompasses physical security, host security, logical network security, transmission level security, database security and operational security.

Salesforce.com is ISO27001 certified, SAS 70 Type II audited and SysTrust certified. We are a signatory to the US-EU Safe Harbor and have been certified by TRUSTe. We are also certified with the Japan Privacy Seal (JIPDEC).

Perhaps the best evidence of our security, however, is the fact that over 77,000 organizations around the world trust their information to the Salesforce.com enterprise cloud. Included among these customers are organizations that place a high premium on security, including financial services institutions, Fortune 500 companies, healthcare firms, technology companies, and governments.

We are encouraged by the actions the Obama Administration has taken to align the federal government security certifications with the cloud computing model and to streamline the security audit process. Programs such as FedRamp and Apps.gov are positive steps, and we look forward to working with federal agencies on these and other initiatives designed to facilitate the government's ability to use cloud computing.

Interoperability

Interoperability is also frequently raised as an issue for anyone considering cloud computing. No matter how powerful an individual company's cloud services are, they will not be effective unless they interoperate with outside software programs. For this reason, interoperability is a core feature of the Salesforce.com enterprise cloud. Perhaps the best indication of the extent to which Salesforce.com interoperates with other software programs is the fact that over 50% of the transactions we process are handled through our application programming interface (API). In everyday terms, this means that about 150 million times each day our computers are talking with other computers outside our system – or "interoperating" – without the intervention of individuals.

Salesforce.com provides interoperability at several different levels. We offer application mash-ups with other software programs, such as Google and Hoovers; native enterprise resource planning (ERP) connectors with SAP and Oracle; and native desktop connectors with Lotus Notes and Microsoft Outlook. We maintain an integration partner ecosystem that includes companies like Deloitte, Accenture and Acumen, and offer developer toolkits for .Net and Java. In April 2010, we announced a partnership with VMWare that will allow the 6 million enterprise Java developers to write cloud computing applications on the Force.com platform in the Java programming language. Our cloud services also interoperate with other major cloud companies, like Google and Amazon, and can be used on desktop, laptop and notebook computers, as well as on mobile devices like the iPhone and the Blackberry.

In addition, Salesforce.com hosts AppExchange, which is like an iTunes for enterprise cloud software applications. AppExchange is an online directory that provides customers a way to browse, test-drive, share and install application developed on our Force.com platform. Partners and developers can offer their applications on the AppExchange directory. This directory gives our users a way to find and install applications to expand

their use of the Force.com platform to areas that are complementary to or extend beyond customer relationship management solutions.

Conclusion

Cloud computing is a powerful technology that promises tremendous benefits for consumers, companies, non-profits, and governments. It has already been successfully implemented in organizations of all sizes around the world. According to Gartner, the cloud computing market was worth approximately $46 billion in 2009 and will increase to $150 billion by 2013. Gartner predicts that next year 25% of new software deployments will be based on software-as-a-service cloud computing applications. According to a recent Goldman Sachs technology software report, the shift toward cloud computing is "unstoppable." The remarkable growth of cloud computing is not limited to consumer and business applications. Numerous federal, provincial, and local governments in North America, Europe, and Asia have also implemented cloud computing solutions. Led by federal CIO Vivek Kundra, the U.S. federal government is emerging as a leader in public sector efforts to take advantage of cloud computing.
I appreciate the Committee's interest in this issue and your efforts to advance the federal government's ability to take advantage of this important new technology.