

Cloud Computing in Government: The Case and Considerations

WHITE PAPER

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INTRODUCTION

The state of the government information technology (IT) infrastructure and capital investments are, if nothing else, immense. Government departments and agencies — civilian and defense — have a long history of infrastructure investment that has created a vast and expensive ecosystem to support business needs and missions. While private sector organizations had a similar history, they were quicker to move to new models, such as software as a service, to reduce marginal operating costs, maximize infrastructure usage, and improve service delivery. Unlike private sector companies, government has become mired in an expensive infrastructure operations and maintenance environment that has consistently eaten up as much as 70% of overall IT budgets.

To begin to bring down these costs, federal, state, and local governments have recently embarked on a number of initiatives, including datacenter consolidation, service-oriented architecture, desktop and server virtualization, software as a service, and, more recently, infrastructure as a service. The most recent and most promising is cloud computing.

IDC defines cloud computing as consumer and business products, services, and solutions delivered and consumed in real time over the Internet.

Key attributes include:

- Shared, standard service — built for a market (public), not a single customer
- Solution packaged — a "turnkey" offering, integrates required resources
- Self-service — administrative, provisioning; may require some initial training
- Elastic scaling — dynamic and fine grained
- Use-based pricing — supported by service metering

- Accessible via the Internet — ubiquitous (authorized) network access
- Standard UI technologies — browsers, RIA clients, and underlying technologies
- Published service interface/API — Web services, other common Internet APIs

There are two broad categories of deployment:

- **Public** — open to a largely unrestricted universe of potential users; designed for a market, not a single enterprise
- **Private** — designed for and access restricted to a single enterprise (or extended enterprise); an internal shared resource, not a commercial offering; the IT organization is the "vendor" of the shared/standard service to its users (A variation of this model is the private hosted cloud in which a vendor or vendors perform the role of the internal IT organization.)

Government Cloud Computing Constructs

Cloud solutions can be deployed in several ways. There are essentially three primary models being deployed in government:

- **Public clouds** offer a "pay as you go" model. Think of this in the same way as an electrical utility. Users pay for what they use, and only what they use, and usage may ramp up and down as needed. Models for public cloud solutions include hosted Web servers, hosted email services, and common business solutions such as office software, small software development platforms, and hosted Web stores.
- **Private clouds** are often built using virtualized servers that exist within an organization's own datacenter or within an associated facility (such as one government agency offering private cloud services for another). On private clouds there may be the same services mentioned above, but using an organization's own software licensing models, be it per installation or per end user. Government shared service centers, which serve multiple other government users, are examples of private cloud solutions.
- **Private hosted clouds** are similar to private clouds, but they usually are located offsite, away from a government facility. Examples of private hosted cloud solutions are Medicaid management systems that are built and hosted by commercial systems integrators, which then offer the solution nearly turnkey to end users, such as state health and human services offices. Some vendors are now offering hosted email services, where they provide a set of private dedicated mail servers that sit in the vendor's data facility.

WHY CLOUD? WHY NOW?

Interest in cloud computing is rapidly increasing among government agencies. This growing interest is due to technologies associated with cloud systems, which offer great potential as cost-effective, easy-to-deploy computing solutions in an era of tight budgets and rapid program and policy changes. According to a recent IDC survey, over 50% of government respondents indicated that cloud solutions are currently in their technology road map, and we expect that number to increase significantly in the coming year.

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Cloud computing as a potential long-term IT solution is appearing at a time when government enterprisewide system consolidation is a high priority. The Office of Management and Budget (OMB), along with the Federal CIO Council and Federal CIO Vivek Kundra, has outlined some very specific steps that agencies must follow in planning for long-term changes to the way they use, manage, and grow both large and small datacenters. Agencies are developing consolidation plans, and many are eyeing one or more cloud technologies as a quick way to accomplish specific consolidation and cost-cutting tasks.

This makes for a "perfect storm" of sorts because, as agencies move to consolidate multiple systems into a common computer platform, many applications, services, and solutions are being standardized through Apps.gov to the point where they can be purchased as a service rather than implemented as agency-hosted systems.

Meeting Government Operational Needs

At its core, cloud computing is a business services delivery model designed to help government agencies procure and consume IT solutions as needed on a pay-for-use basis. It allows government agencies to move costs from capital expenditures to operating expenditures while allowing government IT organizations to become more agile and service oriented. It's an innovative model that helps agencies think differently about what a government IT organization should provide and how it can provide it.

Government agencies operate in a unique environment with inherently different governance structures, funding mechanisms, business cultures, and accountability metrics than private sector organizations. Policymakers have long sought to get better program results through tighter funding restrictions and accountability controls with an eye toward better outcomes, and agency IT organizations have repeatedly been called upon to more definitively tie IT value to program outcomes, which has proven to be a challenge. Cloud computing offers agencies a good opportunity not only to bridge that gap but also to directly offer tangible business program value.

Cloud providers are creating and offering new cloud-based solutions that let government agencies identify immediate and measurable results. This will continue to drive reduced costs, improve scalability, provide new types of service-level agreements (SLAs), and improve overall performance for cloud systems over the next two to four years.

The Driving Trends

Several trends are helping to drive growing interest in cloud computing. Some of the most important drivers are discussed in the following sections.

Cost Reduction/Avoidance

Government budgets are extremely tight, and the pressure is on to reduce operating costs. For common tasks and business processes, cloud offers significantly lower computing costs. For example, the U.S. General Services Administration (GSA) estimates that it has lowered the cost of hosting and support for USA.gov by 72% annually by moving it to the cloud. In a cloud environment, many applications and services run on common or privately owned servers, which gives agencies the ability to retire and/or repurpose some of their most powerful (and expensive-to-maintain) servers and substantially reduce overhead costs. Cloud services typically require minimal up-front investment, and provisioning can be handled quickly. Start-up costs are lower because cloud is essentially a utility with costs spread out over time.

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Agility and Scalability

Government agencies increasingly need computing environments that provide maximum agility and scalability to meet continually changing business needs and new citizen service expectations. Cloud computing has emerged as (in basic terms) a style of IT infrastructure. It was created to provide software, IT services, and other technologies in a utility-style manner. Cloud services provide a robust and reliable level of responsiveness and cost-effectiveness with the ability to scale rapidly. The Defense Information Systems Agency (DISA) has deployed a secure private cloud — the Rapid Access Computing Environment (RACE) — that provides on-demand server space for rapid development teams within 24 hours.

Efficiency/Optimization

As previously noted, there is a surplus of government IT infrastructure. With a cloud environment, agency IT organizations offer functionality by creating it once and reusing it to provision needed services within their existing infrastructure on demand. As agency business needs change or new service demands arise, it gives them the opportunity to optimize infrastructure resources that often otherwise go unused.

System Manageability

Cloud systems use application software that provides Web-based UIs, Web services APIs, multitenant architecture, and a rich variety of configuration options. Cloud solutions offer increased reliability when based on enterprise-grade hardware, built to scale as needed. They can be built with fault tolerant design, which managers of high transaction level government systems should find very useful. Cloud providers usually offer system and application management software that supports rapid self-service provisioning and configuration, usage monitoring, and more. Often this includes automatic "spin up" replacements, which means that new disk drives, storage, and even full servers become available if problems or overloading is detected in existing systems. Human intervention isn't typically needed for these rollovers, which keeps operations flowing evenly.

Access to multiple clouds gives IT system designers flexibility for the solutions they choose, plus the ability to shop for best prices and services. Utility capabilities built into cloud solutions allow for accurate cost estimates and budgeting. And because no advance ordering is needed, cloud solutions have the ability to be turned on and off as needed, helping to reduce the cost of the utility, while commodity open source operating systems and other software have the potential to keep cloud prices low. This also allows greater portability between systems and service providers.

Security

Government has a particular concern about security. Cloud security can be addressed through the use of solid service-level agreements. Security is becoming less of a concern thanks to technical advances that are starting to build select security features directly into virtualized environments. They are evolving into trusted environments, just as there are trusted operating systems for highly secure government servers. Security is an issue with cloud services the same way it is an issue with any computer system, but cloud solutions are not inherently any more vulnerable than other systems. Conversely, they may be less vulnerable because there are fewer applications (and associated security holes) on client machines. In most cases, security issues can be addressed by making specific security-level agreements part of a cloud contract agreement. Today cloud providers offer multiple types of committed service-level agreements and compliance with infrastructure operating procedures to ensure that data security concerns are addressed.

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Availability and Stability

Cloud computing provides for dynamic provisioning of resources, a fundamental function of a cloud computing architecture. All resources are dynamically migrated to other points in the cloud as needed so that there is essentially no downtime. As a result, one event or anomaly will not take down an entire system. Cloud providers use reliable IP

networks to connect parts of a cloud and to connect end users to cloud services. This allows most government networks to leverage network-embedded technologies already in place, including security. Many cloud applications are designed to start working immediately. Additional parts of the application are only transferred, in modular format, as needed. Cloud systems can also help with information assurance. Information can be backed up automatically by the main system. Cloud systems can be reached from multiple locations, and data can be stored centrally.

PRACTICAL APPLICATION OF CLOUD COMPUTING IN GOVERNMENT

The government environment is ripe for the practical application of cloud computing to address several of its primary priorities.

Datacenter Consolidation

Government agencies are under pressure to consolidate their sprawling operations. In February 2010, the federal CIO issued datacenter consolidation guidance to agencies for the creation of agency datacenter consolidation plans. Agencies must consider agency datacenter performance and utilization metrics, energy efficiency use data, physical facility, operational cost and asset information, best practices, open standards, and security. Agencies are to submit their datacenter consolidation plans by August 30, 2010. Combining computer systems isn't just about reducing numbers of machines; it's about merging resources around common needs and missions. Consolidation won't pay off in a truly big way until agencies get beyond the notion that they need to maintain their own applications, systems, and full datacenters.

Secure Telework and Continuity of Operations

Government agencies have a mandate to ensure continuity of operations (COOP) for critical government services. Telework has been alternatively treated as a COOP strategy and as a workplace strategy for meeting multiple goals, including attracting needed new skills and workers into the government workforce and reducing traffic congestion and pollution in large metropolitan areas. Information security has presented a formidable barrier to telework, primarily due to data control issues (i.e., resident laptop data that is at risk). Cloud computing changes this risk by maintaining data securely in the cloud and turning the laptop (or other devices) into access tools that allow users to securely work with resident data.

Cloud systems can also offer nearly unlimited storage capacity and, if needed, nearly unlimited processing power. They also offer increased data reliability. Unlike desktop computing, in which a hard disk crash can destroy all of its valuable data, a computer crashing in the cloud doesn't affect data storage. In a world where few individual desktop PC users back up their data on a regular basis, cloud computing is the ultimate in data-safe computing. Cloud takes away many of the traditional arguments (data security and accessibility) from telework arrangements; government agencies can move on to deal with the remaining barriers, which are largely organizational management issues.

Reduced Energy Consumption

As IT infrastructure resources are virtualized and combined, each office and agency does not need to have its own dedicated IT infrastructure. Because programs used by employees can now run on remote servers — as opposed to desktop PCs — the employee PCs won't need as much processing power or hard disk space as they once required. As desktops are virtualized, energy consumption is substantially reduced. Multiple groups share computing resources, leading to fewer servers and lower energy consumption. The federal CIO has indicated that if agencies don't start conserving power through cloud computing, government computer server electricity will grow to 12 billion kilowatt hours in 2011 from 6 billion in 2006.

Enabled Enterprise eGovernment

On the minds of forward-thinking government business and IT leaders is the essential mandate to take siloed transactional e-government applications to the next level that creates a single view of the customer but, more importantly, delivers services based on that view. Government has vast quantities of data that, to this point, remains of limited value based on government's inability to rationalize and organize it in ways that increase its business value.

From a functional service level, cloud services offer easier group collaboration. Sharing applications, documents, and storage space can not only enhance project collaboration but also begin to open business processes and capabilities across government organizations. While this will likely start in shared services environments that are largely internal to government operations, cloud computing offers a much quicker rationalization of processes and applications that can accelerate the move to enabled enterprise e-government.

FROM EXPLORATION TO MIGRATION

Government agencies are rapidly moving beyond the exploratory path into the migratory path to cloud computing. The Federal Cloud Computing Initiative was announced in September 2009 by the U.S. General Services Administration with a stated goal of achieving "an optimized, cost-effective, governmentwide information technology infrastructure that supports agency mission while providing reliability and security in service delivery." Beyond that, as a part of submitting plans for the federal government's datacenter consolidation initiative, agencies must detail how optimization through server virtualization or cloud computing alternatives may be used to achieve their goals.

Standards are needed to accelerate this move, and they are being discussed and developed by the National Institute of Standards and Technology (NIST) along with guidance to jump-start cloud computing. States are discussing and developing standards through various organizations and are closely watching and collaborating with federal efforts.

The move to cloud is evolutionary, requiring a shared vision among government IT organizations and lines of business, strategy for what can appropriately be moved into the cloud, and assessment of the underlying infrastructure needs. It is a journey from partial virtualization to pooled virtualization. Agencies add workflows into the cloud environment and determine how to view, maximize, and manage them. As the ecosystem takes shape, organizations need to manage the environment with a view toward optimization. Through these phases, business process and IT owners can work collaboratively to achieve mutual goals of cost reduction and improved service.

Beyond that, government can maximize cloud computing value by moving from single-tenancy to multitenancy environments, which may be the ultimate goal for realizing cloud's full potential benefit. There are substantial government and agency cultural issues that need to be overcome through concerted and focused change management, but if government line-of-business and IT owners come through the evolutionary process together, they will see that it's the next logical step. The process is a discipline that offers the best potential for moving forward.

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CLOUD IS BECOMING GOVERNMENT'S CHOICE FOR THE FUTURE

Cloud computing solutions offer a compelling choice for government, and new cloud solutions are appearing nearly every month. Federal, state, and local governments are rapidly moving into cloud computing environments that will help them emerge from a long and expensive legacy of IT infrastructure investment as they struggle to meet new

service needs in a very difficult budget environment. Cloud benefits include cost reduction and avoidance, agility and scalability, infrastructure efficiency and optimization, system manageability, increased availability and stability, and improved security. These benefits meet government operational needs head-on.

At this point, cloud computing environments offer the most dynamic, configurable, and adaptable — and very likely the most cost-effective — IT solutions to accommodate government business needs in a rapidly changing economic, social, and public safety climate.

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