Teresa Bozzelli
Vice President, Government Markets

THE U.S. PUBLIC SECTOR FACES INTENSE PRESSURE FOR COST CONTROL AND IMPROVEMENT OF GOVERNMENT SERVICES

Today is a time of crisis, chaos, and challenge. Our governments and educational institutions have not been spared in these tough economic times and are facing severe budget shortfalls today and likely for several years to come. The tax base has eroded and rainy day funds are depleted, presenting significant management challenges for public sector organizations. Add to the current situation the increased demand of consumers, including citizens and student, who expect to interact with government and educational organizations in the same way they can with their financial institutions and online retail outlets. It is increasingly evident that the public sector needs a new model using the Internet as the primary channel for communication and services delivery.

The longer public sector organizations delay in moving to more innovative and interactive methods, the faster they fall behind their private sector counterparts. To date, government exploration and adoption of social media, virtualization, cloud computing, and spatially-enabled information has been slow. The government often struggles to capture and adopt innovative solutions given policy restrictions and requirements to secure access to public information assets. With a renewed emphasis on government accountability, a promise of transparency in government decision processes, more open access to government information, and an emphasis on citizen participation in government processes – today truly is the time when technology can serve as an essential accelerator to success. However, if we continue to view government services and technology acquisition and use within the current model, the question of how to efficiently deliver better government and improved educational services with tightly controlled costs seems unanswerable.

COMMON ISSUES THAT PUBLIC SECTOR MUST ADDRESS IMMEDIATELY

All levels of government are struggling with budget and spending when it comes to their fiscal responsibilities. With the increase in the cost of providing education, delivering government services to citizens, stimulating the economy, protecting our homeland, and deploying the war fighter, the budgets and debt are increasing at alarming rates. Escalating even more rapidly is the demand of consumers. Citizens expect open access to government data, the ability to engage in two-way dialogues with government decision makers, and timely responses to their comments or questions. While this new

level of consumer participation drives better services and value, it also drives up the cost of providing government and educational services. Under these circumstances, innovative technology may be one of the few viable options to address this conundrum. While ultimate success requires new technology innovation, an immediate value in government and education can be achieved by more rapid adoption of current technologies and with more innovative architectural and service models.

There are three specific challenges facing the public sector today. First is the enormous inventory, compounded by the continual propensity to create unique and dedicated solutions for each government program and educational department. Historically, information technology decisions have been influenced by managers focused on preserving the status quo, including "It will not work if it is not invented here," "my data is unique," and "control must be maintained at the lowest level." The result of this kind of thinking has been that numerous silos of data and duplicative applications have been created that do not interoperate and often produce conflicting results. The second challenge for public organizations is the diversity of technology environments which hinder the adoption of technology refresh programs and the introduction of innovate, new applications and strategies. Third is the abundance of contractual arrangements that hamper the government from receiving the full value of timely technology advancements. The reality of re-competing contracts often creates a surplus of infrastructure that cannot be continued between contracts or transferred from one contractor team to its successor. With the public sector being held accountable for cost control and improved service, these issues for information technology acquisition and deployment must be addressed.

FEDERAL GOVERNMENT MARKET DYNAMICS

The government market is the largest single buyer of information technology (IT) in the world. A bit closer to home, the government trends and issues drive nearly 15% of total IT spending in the United States.

The Federal government is leading the technology spending and increasingly driving innovation. Through efforts in the U.S. Office of Management and Budget (OMB) since 2003, the Federal Government has achieved a clear understanding of IT spending via a centralized IT investment management process based on a comprehensive Federal Enterprise Architecture and reference models to identify and eliminate redundant requests for funding. The result of these initiatives has been development of service-oriented approach to IT resource acquisition, development, and deployment. To prevent every government organization from having to fund and build duplicative solutions for human resources, financial management, citizen services, and other enterprise systems, OMB has sponsored shared service data centers, such of the Department of Agriculture's National Finance Center, the Department of Interior's National Business Center, the General Services Administration's Customer Service Center, and the government wide USA.gov portal.

However, the Federal government also struggles with funding innovation. The IT funding cycle for capital investments begins with a detailed business case 15-18 months prior to the time when approved

initiatives receive funding.. This funding cycle clearly does not track with the speed of technology innovation. By the time a request is funded, a new generation of technology has made the solution obsolete. Likewise, the Federal government is spending an increasing percentage of its budget on maintaining existing IT solutions each year, thus decreasing the available funding for innovation. The table below shows the amount of technology investment and Operations and Maintenance (O&M) costs within the annual Federal budget.

	Discretionary Budget	IT Budget	Infrastructure, Office Auto, Telecomm	Infrastructure % of Total IT	Infrastructure % Operations Maintenance
2009	$1,331	$74.2	$19.4	26%	87.1%
2010	$1,437	$78.4	$19.6	25%	87.7%
Source: GPO Access and OMB		$ = Billion			

While progress in technology-enabled government services has been achieved, the reliance on capital expenditures and the lengthy budget cycle is a hindrance. This cycle must be broken in order to achieve successful government programs with improved services and controlled cost. Under the leadership of Federal CIO Vivek Kundra, OMB has created an IT strategy with great promise. With key priorities of accountability, transparency, security, innovation, and excellence of service, the stage is set for an increased focus on the reduction of agency-specific silos of infrastructure as a means of cost control and improved information sharing. An additional innovative step is moving to "Infrastructure as a Service," specifically cloud computing as a means of providing on-demand computer resources, government data, and government services over the Internet. OMB has stated that cloud computing is a cost effective use of resources and a means to accelerated innovation, resulting in improved government transparency, accountability, and service value.

State and Local Government Market Dynamics

Budget deficits and increasing citizen demands are even more pronounced issues within state and local governments. With nearly $185 billion in state budget gaps between 2009 and 2010 and only a handful of mineral rich states not taking extreme cost cutting measure to balance their budgets, this is indeed a dire situation. Similarly to Federal government, state and local government acquisitions processes are lengthy with cost often taking precedence over innovation. Unlike the Federal government, state and local governments cannot operate without balancing their annual budgets. Most state and local government technology budgets struggle to obtain sufficient capital budget for rapid modernization and technology solutions for citizen service. Some highly populated states, such as New York, are fortunate to obtain 15% capital funding to build and sustain a robust computing network for citizen safety and

service. But states with smaller populations, such as Utah, only can allocate 5.4% of their state technology budget to capital investment. With personal income tax revenues projected to fall 26% for 2010 and limited ability to generate new revenue, government leaders must look to technology innovation to create efficiencies within operations to address the increased expectations for citizen service.

State and local government officials face additional challenges beyond the enormous hurdles of reduced budgets at a time of increased citizen demand for more and improved services. While government officials are turning to information technology as a means to enable better government service without additional funding, they are finding some unique challenges. Most states face a shortage of qualified staff to run technology programs and data centers, making rapid technology advancement nearly impossible. A lack of centralized IT budget control at the state level perpetuates an environment of decentralized IT solutions and information silos that drives higher cost and inefficiency. To compound the issue, over half of the states have policies requiring government data and service contracts remain within state boundaries and jurisdictions, thus restricting the adoption of new technology delivery models.

EDUCATION MARKET DYNAMICS

Academia inherits all of the issues of Federal, state and local government--just in a more distributed and pervasive manner. Educational institutions are struggling with reduced revenue, increased operational cost, and both parents and students expect a more innovative and progressive learning environment. Educational organizations seldom have sufficient money or workload to hire full time technology staff, even if they could find qualified candidates. Several factors outside the control of education officials create additional challenges for the delivery of high quality education at a reasonable price. These include sporadic and cyclical funding due to volatile enrollment, disjointed grants processes and gaps in funding, state government funding cuts, and a propensity of the academic process to create silos of innovation. Educational institutions also must address the issue of student-supplied computing devices with access to institutional networks. The result of students requiring access from any device, anywhere, anytime to local and global data creates an unpredictable computing load and unprecedented demand for bandwidth, and consequently, an unpredictable technology budget.

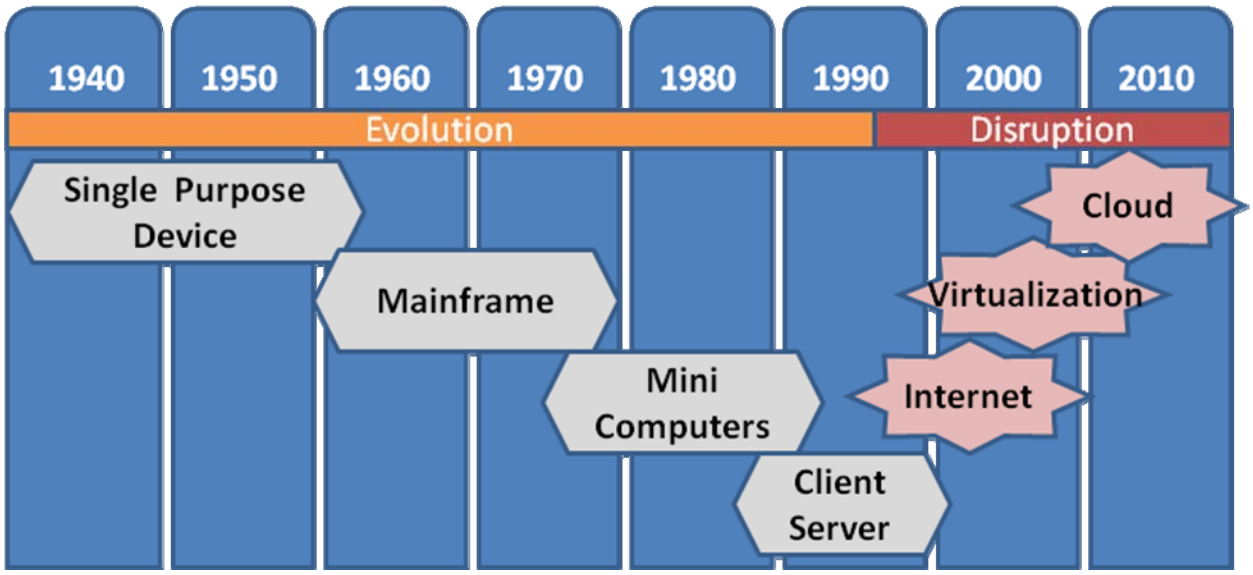
The education market is a diverse buyer set, with nearly 12,000 K-12 facilities and more than 6,300 institutions for higher education. A common denominator for all academic organizations is the need for technology for internal student records management, financial management, and learning development. Similar to government organizations, academia must ensure the privacy of personal data and records. However in most cases, educational institutions are more tolerant of open access, causing a significant challenge to consistent security policy implementation. Beyond these common challenges, K-12, higher education, community colleges, research universities, and professional/continuing educational organizations vary greatly in the sophistication of tools, volume of information, and their ability to adopt technology innovation. The education market is an outstanding source of innovation for

technology-enabled learning, but without a structure and a culture to share technological advances across institutional boundaries; real educational excellence has been somewhat isolated and has yet to advance the competitive posture of our country.

THE COMPUTING EVOLUTION

IN THE BEGINNING

Since the early 1600s, the concept of computing existed, but was defined as someone who calculates. In the 1800s, the concept of programmable operations came into practice. Real computer technology evolved in the 1940s with the first generation analog computer. These mammoth machines were programmable, but were dedicated to one problem at a time. The high cost for purchase and operations, lengthy time to reconfigure, and a short time between component failures restricted computers only to support scientific and government initiatives. With transistor technology redefining the next generation of large mainframe computers in the 1960s, the rapid race to faster, cheaper, more reliable computer infrastructure began. Innovation continued in the 1980s with the reduction in the physical size of compute power into minicomputers and into the 1990s with client/server architectures. Moore's law, the doubling of compute power per square inch every year since the integrated circuit and data density doubling every 18 months, continues to predict the explosion and power of modern computing. Add to the power of computing the pervasive nature of the network and the result is the World Wide Web – which provides the ability to share information from anywhere to anywhere. Still, computing resources have been configured for specific purposes, often creating silos of information and operations with high cost to the redundancy necessary to ensure 99.99% availability. With the innovations of multi-core processors per board, the ability for high density computer hardware to consume less power and produce less heat, and the ability to create virtual machines within a single hardware component, computer technology has become the powerful and pervasive network fabric that runs daily life, industries, governments, and the world.



In government and educational organizations, the implementation of computer technology began as a purchased resource that was programmed and maintained by dedicated government staff. However, skilled technology resources were scarce, and the government turned to the private sector for expertise. The government relied on the competitive acquisition process to obtain hardware, software, and technology staff augmentation. Over time, the technology contracts have evolved so that the government buys integrated solutions and services. Contracts require the service provider to select, buy, and operate computer resources. These contracts require significant capital expenditures, either directly or as cost passed on to the government.

In the Future

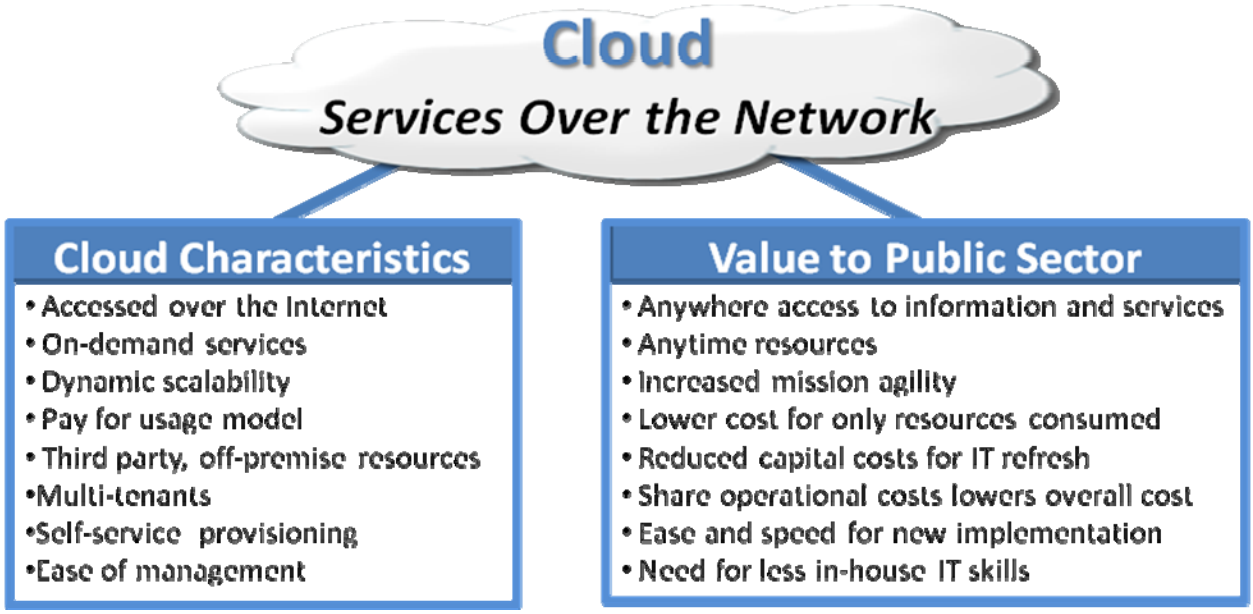
There is a new delivery and service model for computing capabilities. Actually, a new more powerful implementation of an old concept for cloud computing. The new computing cloud takes advantage of recent innovations of virtualization, increased power, and reliability of computer components. These innovations, combined with the ability of the next generation network to provide programmable intelligence, remote operations, and automated controls makes today's cloud computing the next accelerant for technology. Very simply stated, cloud computing is the delivery of a service or capability over the network. Cloud computing is often segmented into three areas:

- Software as a Service (SaaS) – Applications services delivered over the network. Offered as a subscription or free service. Examples include Google Gmail, Cisco WebEx, and Salesforce.com.
- Platform as a Service (PaaS) – A software development framework and components all delivered on the network. Offered as on-demand, pay for usage model. Examples include Google App Engine and salesforce.com.

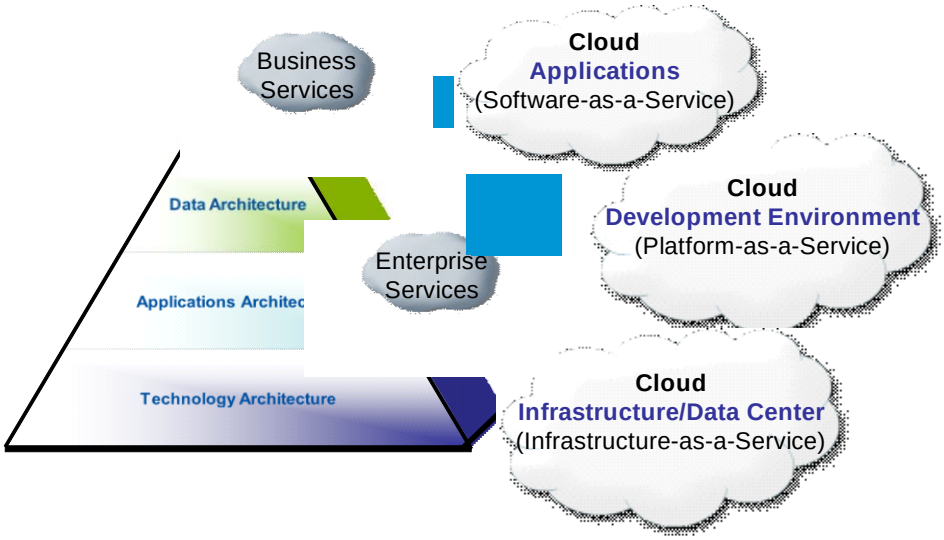
- Infrastructure as a Service (IaaS) – An integrated environment of compute resources, storage, and network fabric delivered over the network. Offered as an on-demand, pay for usage model. Examples include Amazon EC2 and GoGrid.

The common denominator of all of these cloud computing models is the enabling technology architecture. Network components, storage, and servers are the essential building blocks that power cloud computing. It is the pervasive capability of the network that enables anywhere, anytime access to compute resources in the cloud.

In order to take advantage of cloud services over the network, government and education decision makers must understand cloud computing cost, management, and control features. These characteristics, shown in the following graphic, will drive how rapidly cloud can be deployed within the public sector.



In addition to cloud characteristics, it is important to understand where and how different types of cloud services fit within the overall enterprise architecture used to plan and deploy IT resources for the organization. The graphic below provides descriptions and relationships of different cloud services mapped to the traditional architectural components. Design decisions for cloud implementation must be based on architectural components and technology standards to deliver the best value and to ensure that cloud computing implementations meet the organizational missions of the government and educational institutions they support.



While there are multiple services available over the network, the foundational element for all successful cloud implementations is the infrastructure. This includes the intelligent network fabric on which other cloud services are delivered. The infrastructure is the common critical success component for information and services anywhere, anytime, and with appropriate control and monitoring. The remainder of the discussion in this paper will focus on the need and value of the "Infrastructure Cloud" for government and educational operational excellence.

THE INFRASTRUCTURE CLOUD HOLDS PROMISE AND REALITY FOR INCREASED PUBLIC SECTOR RESULTS WITH MINIMAL CAPITAL INVESTMENT

OMB estimates the Federal government spends more than $30 billion annually on infrastructure resources and service. This is nearly equal to spending on IT resources for mission-specific performance. While the state, local, and educational organizations tend to allocate a smaller percentage of IT spending to infrastructure, the total investment still is in the billions of dollars. Public sector leadership must recognize the rapid convergence of three drivers indicating that *"today"* is the most critical time for technology-enabled government service improvement.

- Shrinking government and education budgets
- Citizen and student demand for improved services and more open access to information
- Rapid technology advances in hardware and network capabilities, and cost

Technology innovation is the accelerator for improving government and educational services Specifically, Infrastructure as a Service or the Infrastructure Cloud holds the most immediate opportunity to reduce capital expenditure, optimize operating costs, and improve the use of available IT staff. Ultimately, the real value is in the ability to apply constrained budget and talent resources to meet mission objectives. Improved performance is the highest priority, while there is incredible value for governmental and educational institutions in many other areas that result from technological innovation. Utilization of the Infrastructure Cloud improves the green footprint for government, allows management support from more cost-effective geographical locations, and architecturally embeds capabilities for systemic continuity of operations.

CLOUD RELATED INITIATIVES UNDERWAY

There is incredible opportunity and need for Infrastructure Cloud initiatives in government and education, and there are significant and successful cloud projects underway. These programs are led by the risk takers in the public sector. These innovators deserve kudos and continued support as the real value of their initiatives has only begun to be articulated. A few Infrastructure Cloud projects underway include:

- The Department of Commerce, National Institute of Standards and Technology (NIST) has led the development of consensus definition for cloud as 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. NIST further define characteristics, delivery models, and deployment models.

- The Defense Information Systems Agency (DISA) has built an internally-controlled private cloud called Rapid Access Computing Environment (RACE). This cloud includes services for infrastructure, platform, and software, via a self-service portal over the agency's internal network.

- The General Services Administration (GSA) is actively investigating and preparing for adoption of public (not owned and controlled by the government) cloud capabilities. GSA is engaging in discussions with private sector technology providers on critical issues such as pricing, service level agreements, security, and interoperability.

- The NASA Ames Research Center has launched a cloud computing environment called Nebula. This initiative is a combination of infrastructure, platform, and software service over the network.

- The State of Florida has created a master contract for statewide access to computing resources.

- Washington and Maine have statewide data center modernization contracts, despite their budget constraints.
- Texas and Virginia currently use private sector providers for technology services and resources.
- Selected educational institutions also have adopted innovative use of cloud capabilities:
    - Some universities in Florida use publicly-hosted e-mail services.
    - Numerous university systems, including Stanford, Texas A&M, and Carnegie Mellon utilize iTtunesU to provide educational materials and guest instructors from around the world to students anywhere and anytime.
    - The University of California at Berkeley uses podcasts over the Internet to distribute educational materials.
    - Numerous school districts operate third-party hosted data centers to support their K-12 schools.
    - Numerous schools have implemented learning management systems, such as Blackboard, for online collaboration in the classroom.

CLOUD COMPUTING CHALLENGES STILL EXIST: PERCEPTION OR REALITY?

While there are incredible benefits for government and education to incorporate Infrastructure Cloud into their overall strategic enterprise architectures, there are some barriers to adoption. Some of these roadblocks to cloud adoption are real, but most are perception.

In formal and informal surveys of public sector leaders, security is always the top concern for cloud implementation. In the public sector, these concerns are both real and perceived. . Security in the cloud must address authorized application access over the network, as well as restricted data access to ensure privacy and limit unintended data disclosure. The security landscape is complicated by conflicting federal and state government policies that restrict the physical location of data. The nature of the public cloud for multi-tenancy and third-party location will tend to restrict some government situations from full adoption of cloud computing. However, a private cloud approach or an infrastructure architecture that incorporates public cloud components into the private cloud can provide high value while ensuring security compliance. In many cases continuity of operations and disaster recovery become an added value of cloud implementation programs.

Many barriers to cloud adoption are founded on perceptions that exist due to lack of documented results to date and by a history of inappropriate contractual agreements. Using cloud computing

services and their related pricing models represent a major change in how government and educational institutions operate. The cloud approach for infrastructure capability does not fit easily within the government capital expense budget process or prevalent contractual structures. Some of the other perceived cloud challenges are:

- Performance and availability of services
- Control of architecture decision and service level agreements
- Vendor lock-in and ease of transition
- Integration with existing solutions
- Contracting, cost, and governance models

However, the most significant issues are cultural. It is lack of trust and the fear of losing control, not technology implementation that is slowing Infrastructure Cloud adoption. Historically, control and accountability have rested solely on the shoulders of government and educational officials. The highly competitive contracting requirements often create an environment of conflict between technology providers, as well as with the government buyer. To truly receive the optimal value of the Infrastructure Cloud, contractual arrangements and private/public sector partnerships must evolve for improved trust and control.

CLOUD COMPUTING ADDRESSES KEY ISSUES FOR PUBLIC SECTOR ADOPTION

The underlying elements of success for Infrastructure Cloud implementation are three-fold. First, is virtualization, which provides the ability to create multiple instances of emulated computing capability within a single, physical instance of computer hardware and to manage these resources independently, remotely, and dynamically via the network.

Second, is intelligence within the network. Current innovation in network devices and fabric allows for many capabilities to be embedded in the network that previously required separate devices (i.e., switch, cables, and adaptors) or manual operations. Security can be enhanced with automated enforcement of configuration standards and security policy across all physical and virtual machines within the network. Embedded management features increase visibility of network activity and provide the ability to dynamically alter load and traffic based on time or events. This intelligent network now enhances operational efficiency, security, and business continuity, which are critical public sector issues. .

Third, is the robust ecosystem of private sector suppliers of storage, server, and network components. This ecosystem is necessary to ensure interoperability and timely technology upgrades within the cloud

architecture. It provides the means for government and educational buyers to obtain services independent of specific vendors and to avoid vendor lock-in.

These three elements of technology advancements, a strong partnership ecosystem, in combination with the new pay-for-usage model, make today the right time for government and educational organizations to aggressively pursue immediate adoption of the Infrastructure Cloud.

The remaining barriers to cloud computing are lack of trust, fear of losing control, and the potential impact of multi-tenancy on the protection and use of data. These issues must be addressed with a combination of progressive procurement reform, reassessment of policies for appropriate security and privacy, and when necessary, private cloud implementations owned and/or operated by the government.

GOVERNMENT AND EDUCATION OFFICIALS MUST CONSIDER CLOUD COMPUTING TO ACCELERATE INNOVATION WITH RAPID RETURN ON INVESTMENT

THE VALUE

Government and educational organizations are facing challenges from all sides and with an intensity not seen for decades. Budgets are shrinking, demand for services is increasing, and technology advances have empowered citizens and students with access and tools that allow them to become participants, not just consumers of public services. Capital expenses for new technology are hard to justify when so much money is needed for mission performance in these times of escalating expectations. Public sector leaders must turn to technology innovations as a way to deliver better information and services with lower IT costs. The cloud computing delivery and operations approach has proven to do just that, and the Infrastructure Cloud delivers the highest value for services with the lowest capital expense. Cloud computing is both economically and environmentally green.

THE TIME

There is no reason for government and education leaders to wait. All of the technological innovations for implementing the Infrastructure Cloud have matured and are ready for public sector adoption. The leadership at OMB has set the stage and defined a strategy for cloud adoption for infrastructure, software, and platform. The Federal government is viewing the cloud as a means to embrace and promote participatory government for and with the people. State and local governments are aggressively looking for ways to balance their budgets and eliminate unnecessary capital investments in technology. Educational institutions must deal with student-driven innovation via the cloud. The need to adopt is obvious and immediate.

THE NEXT STEPS

The first step is to understand what infrastructure resources currently are in use within your organization. If the enterprise architecture is defined based on service-oriented architecture, you have a good baseline for understanding which services can be moved to the cloud. Work with the enterprise architect to identify the data and applications that can co-exist and outline the physical and ownership boundaries of the organization, and what must be maintained within the organization to comply with policy restrictions.

Create a cloud integration and migration business plan based on operational expense and avoiding capital budget requirements. Begin with easy Infrastructure Cloud targets, such as a development and test environment or storage in the cloud for cyclical data collection cycles. Other targets would include day-to-day processing for internal operations. Ensure the proposed Infrastructure Cloud plan addresses both private and public cloud components to ensure that government-specific security and privacy compliance is maintained in the most cost-effective manner.

Most importantly--take action! Begin with understanding specific public sector potential and benefits of the Infrastructure Cloud. Create the business case to move to the Infrastructure Cloud. Government and educational leaders cannot afford to miss this opportunity to improve service delivery while reducing cost. Technology-enabled capabilities are necessary to achieve the participatory engagement model demanded by the citizens and students of the 21st century.