Abstract

The Federal Government faces significant challenges in the face of budget constraints limiting important investments in new technology. Cloud computing services offer value in solving many of these challenges. These services have evolved from simply offering low cost compute towards providing complete IT solutions, consumed on-demand. IBM has a vision for building on this broad and deep technology base with Cloud Business Solutions, to meet current and future Federal needs. This vision is substantiated by our highly successful history of solution delivery to the Federal Government. In the future, we predict that cloud computing services will become “systems of insight” where cloud-based services will leverage emerging technology to optimize operations for public sector and commercial customers alike.
Introduction

Today, business computing environments are increasingly being delivered via cloud services, with focus on customer value, speed, and scale. Government agencies are taking action to implement their workloads on the cloud “first” whenever possible. We observe that “as-a-service” is disrupting traditional business models and technology consumption paradigms. Further, agile, scalable, and consumable services are shifting the business services market as cloud similarly shifted delivery of IT.

Forward leaning organizations are departing from traditional on-premise, annuity based delivery methodologies, often associated with significant and slow capital expenditure (CapEx) commitments. Instead, they are adopting variable subscription based operating expense (OpEx) cloud based delivery models. These organizations realize the value proposition and opportunities in adopting this new norm of doing business via cloud technologies.

Cloud spending, including cloud services and the technology to enable these services, will surge by 25% in 2014, reaching over $100 billion. This approach avoids accelerating infrastructure investments, enabling simplicity, scalability and reliability. The realized cost savings can be readily redirected for other mission purposes.

In the US Federal agencies, the potential benefits of cloud technology for consolidating new and existing IT capabilities is inhibited by the diversity and distribution of infrastructure, configuration data and agency stakeholder priorities. Acquiring and procuring cloud infrastructure often leads to specific requirements to achieve consistent/stable performance, technology extensibility, sustainability, and security controls (e.g. NIST SP800-53r4 and FedRAMP), while priority and funding contention may exist between various organizations, such as mission development, operations and agency leadership.

Clearly, Federal Government agency CIOs face pressure improving the integration of IT with business, achieving improvements in IT operations, and changing the way employees are provisioned with technology. It is also clear that most government agencies are faced with competing mission priorities driven by competing mandates, independent funding sources, and varying workload characteristics.

As agency mission programs begin to use shared IT resources in a multi-tenant cloud delivery model, these programs require a secure environment where those resources can be easily used with confidence, in support of agency mission objectives. Confidence is achieved when there are standards and guidelines for procuring a supporting cloud environment with control and transparency, segregation between tenants and between programs, and proactive management of quality, flexibility, and resource usage.

This paper discusses Federal challenges in light of these observations and trends, how cloud investments can address these challenges, how IBM solutions offer help in today’s environment and expectations of future technology to surpass current limitations.

US Federal IT Challenges

The US Federal Government spends approximately $80 billion dollars on Information Technology (IT) annually. However, a significant portion of this spending goes towards maintaining aging and duplicative infrastructure. Instead of highly efficient IT assets enabling agencies to deliver mission services, much of this spending is characterized by low asset utilization, long lead times to acquire new services and fragmented demand. To compound this problem, Federal agencies are being asked to do more with less while maintaining a high level of service to the American public.

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1 IDC study forecast - Worldwide and Regional Public IT Cloud Services 2013–2017 Forecast
Cloud computing presents the Federal Government with an opportunity to transform its IT portfolio by giving agencies the ability to broadly purchase IT services in a utility-based model. This allows agencies to refocus their efforts on IT operational expenditures and only pay for IT services consumed instead of buying IT with a focus on capacity. Procuring IT services in a cloud computing model can help the Federal Government increase operational efficiencies, resource utilization, and innovation across its IT portfolio, delivering a higher return on investments to the American taxpayer.

In order to leverage the power of cloud computing across the Federal Government's IT portfolio, the White House established a “Cloud First” policy in the 25 Point Implementation Plan to Reform Federal Information Technology published in December of 2012. Under this policy, Federal agencies are required to “default to cloud-based solutions whenever a secure, reliable, cost-effective cloud option exists.”

Subsequent to the publication of the 25 Point Plan, the Federal Cloud Computing Strategy was published in February of 2013. This document represented the first step in providing guidance to Federal agencies on successfully implementing the “Cloud First” policy and catalyzing more rapid adoption of cloud computing services across the Federal IT landscape.

With burgeoning cloud vendors and service availability, the Government must be adept at strategically determining when to use a cloud deployment model. Budget pressures to decrease operational costs and re-evaluate all current data center leases drive these decisions. The following are some specific Federal Government challenges:

- **Government mandates and directions** sometimes imply that activities may be constrained and the most efficient solution may not be feasible.
- **Security**: Maintaining service and data security, confidentiality, integrity, availability and reliability is critical; in some cases non-negotiable. For example, data security relates not only to individually identifiable information but also national security.
- **Stakeholders may have non-negotiable priorities**: Projects are expected to deliver specific outcomes and may be inconsistent with coordinating for overall optimization.
- **Agency-specific private clouds are ubiquitous**. This may constrain many of the intrinsic benefits of cloud and may imply duplication of cloud management services.
- **Economics may be different from commercial environments**. The budget allocation process may create distortions in short/long run tradeoffs. Mission-focused cost allocation accounting may play an inhibiting role as well.
- **Lengthy procurement processes / long budget cycles are problematic**. Vendor contract negotiation is complicated and critical. There are few customer cloud agreement templates; therefore legal issues, combined with compliance and regulatory requirements, compound the challenges.
- **Standards compliance is challenging**: Increasing needs for transparency and exercising client and industry fiduciary duties to meet compliance controls such as FISMA, FedRAMP accreditation, ISO 27001/27002, PCI DSS and NIST. Program modernization must meet Federal Cost Accounting Standards.

We see trends in Federal cloud procurements that have bearing on how cloud services are acquired. Examples are the need to balance agency mandates while containing costs, balance outcome-optimized yet still comparable proposals, balance dedicated IT resources while being billed by consumption, and balancing acquired technology vs. in-house development. To address these competing values, there is increasing focus on tenant transparency, self-service control, and sustainability. To minimize potential hidden costs of ongoing operations and maximize agility, IBM recommends procuring standards-based but still optimized cloud solutions.

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3 Cloudy with a Chance of Success: Contracting for the Cloud in Government, 2013
based on complete, supported offerings, integrated into end-to-end IT solutions. Acquiring cloud capabilities should consider the full range and lifecycle of stakeholder needs.

**General Cloud Models and Enablers**

The essence of cloud computing lies in providing abstraction layers in the IT infrastructure which enable simplified service requests, speed, agility and granular service delivery, that enable the sharing needed to support consumption-based usage economically. For example, cloud systems provides big data applications with abundant compute power, networking and storage that can automatically and elastically expand and contract as needed for customer growth and business process requirements.

Per NIST’s definition⁴, “cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources … that can be rapidly provisioned and released with minimal management effort or service provider interaction.” The NIST⁵ “essential characteristics” of Cloud Computing are summarized as follows:

- **On-demand self-service.** Consumer ability to unilaterally provision computing capabilities, automatically without requiring human interaction with each service provider.
- **Broad network access.** Capabilities are available over the network and accessed through standard mechanisms, on various platforms (e.g., mobile devices or computers).
- **Resource pooling.** Resources are pooled to serve multiple consumers using a multi-tenant model, allocated dynamically on-demand and with location independence.
- **Rapid elasticity.** Capabilities can be elastically provisioned and released, on-demand
- **Measured service.** Cloud systems automatically control and optimize resource use by leveraging a metering capability based on an abstraction appropriate to the type of service.

Again, per NIST, Cloud’s Service Models offer a framework for enabling complete IT solutions:

- **Software as a Service (SaaS):** The consumer uses provider’s applications in the cloud.
- **Platform as a Service (PaaS):** The consumer creates/executes their applications on platforms (languages, libraries, services and tools) supported by the provider.
- **Infrastructure as a Service (IaaS):** The consumer provisions and uses fundamental computing resources for their software to execute on the provider’s infrastructure.

Business Process-as-a-Service builds on the 3 NIST-defined cloud models. Gartner defines BPaaS⁶ as “the delivery of business process outsourcing (BPO) services that are sourced from the cloud and constructed for multi-tenancy.” As with the other models⁷, pricing is consumption-based (i.e. by-the-drink) or subscription-based.

These services may be deployed via Private Cloud (single organization), Community Cloud (consumer community with common requirements), Public Cloud (open use by general public) and Hybrid Cloud (two or more of the other 3 models).

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Cloud benefits are well-understood and enable more effective and efficient operations:

- **Cost Flexibility**: Market driven approach to minimize IT expenditure thereby shifting fixed to variable costs; pay as and when needed.
- **Business Scalability**: provides limitless, cost-effective computing capacity to support growth while achieving economies of scale thereby passing on lower costs to customers.
- **Market Adaptability**: faster time-to-market; supports innovative ideas by extrapolating and applying big data insights.
- **Masked Complexity**: expand product sophistication; simple interfaces.
- **Context-driven Variability**: user-defined experiences; increasing relevance by creating opportunities from business challenges.
- **Eco-system Connectivity**: new value nets; potential new businesses by exploiting downstream smarter analytics, mobility and social business opportunities.
- **Elastic capacity**: Efficient use of infrastructure resources, affording organizations the luxury of using clusters when needed within seconds while not paying for idle compute infrastructure and power.
- **Sustainability**: keeping pace with the industry on state-of-the art capabilities in services, security, transparency, elasticity, and management support.

**IBM Cloud Computing Solutions for Government**

IBM’s cloud computing solutions for Government provide complete services to execute business processes, analytics and applications as a service, providing the power of cloud to better engage with employees, citizens, customers and extended communities. These include IaaS, PaaS, SaaS, BPaaS and Cloud Business Solutions. For example, we currently offer more than 100 cloud-enabled, commercially available, IaaS, PaaS and SaaS solutions in various cloud environments. IBM Cloud Computing Solutions for Government support development, testing, collaboration, and analytics in FISMA secure environments. Our cloud offerings include a comprehensive set of capabilities for Federal Infrastructure Managed Services. For example, we provide system administration, storage and backup management, enterprise systems management, service desk, NOC/SOC support, security engineering/configurations, and compliance support.

**Infrastructure**

IBM has invested more than $7B in 16 acquisitions to accelerate our cloud initiatives and build a high value cloud suite. IBM is investing in $1.5B in additional data centers at new worldwide locations. We hold over 1,500 cloud patents focused on driving innovation, facilitated by 43 innovation centers world-wide.
The IBM managed services global ecosystem is characterized by its breadth of support for managed services. IBM manages more than 450 data centers globally with 8+ million sq. ft., 1,100 mainframes, and 200,000 midrange servers. IBM operates 238 data centers for clients in the United States, including three FISMA compliant Federal Data Centers, and 10 call centers with multi-tier help desk capabilities.

Essentially, this ecosystem implies end-to-end IT support including integrated managed services that leverage the intellectual capital of Team IBM. Moreover, fine-grained and high control over custom configurations is available. Government benefits include:

- Integrated service delivery and extensible offerings beyond current agency requirements.
- Fit-for-purpose support for workload-sensitive configurations with high-degree of control and customization.

Our solutions incorporate an advanced suite of analytics tools (e.g. SPSS, Cognos), and our Big Data platform (e.g. Hadoop and Infosphere Streams). We are at the forefront of data center technology innovation and cloud service development, especially with the rich capabilities of IBM Research and recent acquisitions such as SoftLayer.

**Federal Data Centers (FDCs):** IBM FDCs are responsible for the delivery of IBM public sector hosting and cloud services. These are FISMA compliant, FedRAMP accredited, green data centers. FDCs house the hardware, software, middleware, data center networks, and peripherals suitable for client environments.

**SmartCloud for Government (SCG):** The IBM SCG system FedRAMP-accredited cloud is delivered as an IaaS offering. This cloud is a secure, multi-tenant cloud exclusive to Federal agencies of the United States Government. Unique privacy and security needs of Federal agencies are maintained, while enabling operational and cost efficiencies via a shared infrastructure, commercial off the shelf cloud technology, functionality, and monthly subscription pricing. The SCG is hosted in FISMA compliant FDCs, located within the IBM Boulder, CO and the IBM Research Triangle Park (RTP), NC facilities. These two sites providing disaster recovery or COOP capabilities supported by data replication.

**IBM Cloud Managed Services for Government (US Department of Defense):** This is an offering for all Defense agencies as a NIPRnet-based DOD Community Cloud designed to meet FedRAMP and DISA security standards (ATO pending). It supports DISA Impact Levels 3-5. It is based on IBM Hybrid Cloud Technology and readily scalable, using IBM’s SmartCloud Orchestration capability from IBM Software Group and PureFlex with Storagewe v7000. It uses the existing NAVSEA/IBM NSOC and Service Desk, and GBS cloud specialists. This is the first DOD sponsor of a DISA impact Levels 3 through 5 cloud, making the Navy is the first agency to be able to move workloads to a DOD approved cloud and be compliant with the DOD cloud directives.

**SoftLayer:** In 2013, IBM acquired SoftLayer, a leading cloud services business for the enterprise. Internally, IBM is already applying SoftLayer for software product development and application test and development work. IBM has integrated SoftLayer into IBM’s cloud portfolio to provide customers a unified global secure platform. SoftLayer enables the delivery of the privacy, reliability and security normally found in private clouds with the economy and speed of a commercial public cloud offering. SoftLayer provisions a breakthrough "on-ramp" capability for born-on-the-web companies, Government and Fortune 500 clients.

With SoftLayer, clients can view performance details, control the full range of functions of their dedicated (called “Bare Metal”) and virtual servers, access network and bandwidth data, manage their accounts and billing and deploy solutions. SoftLayer APIs provide over 2,000 function calls to over 200 services. IBM continues to invest in moving more and varied workloads onto SoftLayer, which allows for rapid provisioning of infrastructure as a service. The addition of SoftLayer’s infrastructure capabilities enables us to expand our public cloud
infrastructure while increasing customer flexibility in cloud deployments through improved hybrid and private cloud functionality.

With IBM SoftLayer’s ability to support highly-available and continuous operations through data replication and multi-site load balancing, the Government’s objectives of redundancy, resiliency, and contingency capabilities are enabled with confidence. IBM’s has the unique ability to deliver dynamic hybrid cloud environments to address U.S. Federal requirements. Further, this demonstrates our approach to investing in standard, commercial, and elastic hosting service offerings. Of the fifteen new SoftLayer-enabled datacenters IBM is building around the world this year, two will have FedRAMP certification, with other new US data centers implemented as FISMA-moderate, demonstrating commitment to Federal security requirements.

Managed Cloud Services for critical enterprise workloads: These services provide fully or partially managed private IaaS cloud environments, optimized for critical enterprise workloads. We offer agency-specific custom and aggressive SLAs for reliability, maintainability, and availability (RMA) with the many advantages of a managed private cloud. These services are specifically designed for supporting mission critical workloads, as well as managed enterprise-grade cloud infrastructure for critical web, mobile and social applications, development/test, and government-specific solutions. They receive ITIL-based support (continuous monitoring, patching, security, etc.), as IBM continues to support the evolving ITIL framework.

Platforms

To support development of new solutions on platform services, IBM is in the forefront of the agile application development methodology with its Agile With Discipline and DevOps processes.

BlueMix is IBM’s new PaaS solution that combines the power of the Open Source Cloud Foundry (www.cloudfoundry.org) with popular languages and IBM SaaS. BlueMix provides the capability to add scaling, capacity, load balancing, and detailed application status monitoring and reporting to frameworks such as Ruby on Rails, Java, Tomcat, and Joomla. This will enable PaaS solutions to stay current for Government agencies.

BlueMix offers a piece of readymade functionality for building applications; it leverages a set of services to aid in simple development applications. In practical terms, BlueMix empowers developers with tools to rapidly build, deploy and manage cloud applications, accelerating exploration of big data, social and mobile workloads. It provides a set of predefined services that leverages OpenStack to deploy virtual containers that host each deployed application, also providing an environment where an application can leverage a set of pre-built services (including third-party services) to make the application assembly easy. BlueMix also simplifies the use of services by managing the provisioning of new instances of the service and the binding of those service instances to an application.

Big Data (MapReduce) as a Service: This offering includes the capability to ingest, analyze, and act on massive volumes of data. Our MapReduce solution leverages IBM technologies such as BigInsights and Platform Symphony, which are based on open source standards. They can be applied, integrated, optimized, and managed by our services organization. These capabilities enable applications to work with thousands of nodes and petabytes of data in a highly parallel, cost-effective manner. Our MapReduce capabilities provide the ability to execute open-source, Hadoop-based, Big Data analytics to use shared resources, optimized for the workload characteristics inherent in the high volume, velocity and variety in Big Data workloads. To assist agencies integrate and manage Big Data, our services organization provides integration support with best practices for tying Big Data analytics into existing enterprise IT processes and workflows, including professional services to enable enterprise-grade Big Data solutions.

Mobility in the Cloud: IBM offers mobile cloud services - reusable cloud services that can be shared across applications and channels. Mobile cloud services are a discrete set of high-value
middleware capabilities designed to be consumed by mobile applications. Mobile cloud services complement a mobile application platform and help accelerate and enrich mobile application development. Key characteristics of mobile cloud services are:

- Hidden server-side complexity, enabling accelerated adoption.
- Platform-agnostic mobile application development via lightweight and easily consumed REST APIs.
- Easy developer on-ramp via a comprehensive SDK.

**Architecture, Strategy and Governance Consulting**

IBM has long invested in formalized architectures, strategy-development processes and governance models to ensure success in major IT investments. The emergence of Cloud-based solutions is no exception – we offer effective intellectual materials in these key areas for our Cloud-seeking customers:

- **Architecture**: IBM’s extensive engineering and integration expertise facilitates superior decision-making and cloud resource consumption for candidate tenant application owners resulting in more efficient, transparent onboarding activities and sustainable cloud computing support capabilities. We have made a strategic investment in our Cloud Computing Reference Architecture (CCRA). Based on open standards, it defines a common cloud architecture framework across private, public and hybrid clouds. It represents the aggregate experience from hundreds of cloud client engagements and IBM-hosted cloud implementations. It provides prescriptive guidance on how to build IaaS, PaaS, SaaS and service provider clouds using IBM technologies. It is reflected in the design of clouds IBM implements for clients, IBM-hosted cloud services, IBM cloud appliances and IBM cloud products. Consisting of multiple detailed documents, it serves as an expert reference for our customers as they develop or extend their own cloud solutions. These assets serve as guides for IBM architects to use to help our clients experience radical cost reduction, faster development times and to achieve high degrees of security, reliability, scalability and control when coupled with IBM consultant teamwork.

- **Strategy**: IBM offers a unique cloud strategy, delivered with professional consulting expertise. The strategy leverages a business model that embeds a hybrid delivery model of on-premise and cloud resident teams capable of building flexible yet highly scalable solutions that meets our cloud client’s strategic goals. Our Global Business Services (GBS) is the market-leading, trusted advisor for the development of security and governance solutions in both regulated and non-regulated environments. We drive engagement with our cloud customers by working alongside them, while understanding requirements and cloud objectives.

- **Governance**: Efficient and effective governance enhances exchange of ideas and facilitates controlled adoption of innovative change across a community, the agency and the cloud provider. We have managed our clients’ governance processes successfully for years through an effective governance framework to evaluate the cost and benefit of new offerings. Our clients rely on us for delivery of SaaS (e.g. Kenexa, Watson, etc), IaaS (e.g. SoftLayer) and PaaS (e.g. BlueMix) cloud solutions, making us the only global enterprise-class technology company that understands blending of service models. At IBM, we support the important task of institutionalizing fundamentally sound cloud governance strategy as part of an enterprises’ overall business strategy. We are convinced that a cloud strategy built on a solid governance strategy can deliver better economics and serve an engine for customer and business growth. Underscoring this conviction are our recent observations that complex, hybrid cloud environments are driving the need for strong cloud and data governance.
IT Optimization and Cloud Migration Services for Government

Many government agency infrastructures are at a breaking point. As server sprawl is endemic, infrastructures have become costly to manage and run and complex to update and modernize. Space constraints and energy consumption have become key issues. IBM's IT Optimization and Cloud Migration Services Offerings are designed to help an agency plan to meet the increasing demands being placed on IT. This is accomplished by analyzing consolidation opportunities in an IT infrastructure, analyzing their related organizational and systems management components and developing a recommendation for consolidating the Government's IT workload and infrastructure.

IBM has a methodology and a supporting suite of tools to enable our clients to move beyond platform consolidation and virtualization into ‘fit-for-purpose’ platforms and delivery models leading to further improvements in efficiency and effectiveness of the IT environment. These goals are accomplished through in-depth analysis of the agency’s IT inventory of applications and services provided by each target environment. Our teams help manage enterprise complexity in consuming cloud delivery models. Specifically, we govern service layers and the allocation and utilization of IT assets, at scale. This approach can blend cloud delivery models (IaaS, PaaS, SaaS) into a single solution to synchronize delivery and enable compatibility with legacy and new technologies.

Consistent policy creation and enforcement provide control, visibility, safety, and the ability to transform human directives into executed policies for predictable results.

We leverage our common migration framework and deployment patterns to identify gaps between candidate and target architectures. We articulate the roadmap for implementing the tenant application candidate into the agency's cloud. Early in the analysis process, we identify tenant application candidates that are not fit-for-cloud, (using methods such as our Workload Transformation Analysis or WTA) or would not benefit from cloud to reduce life cycle costs. For these candidates we advise the application owner to consider our bare metal server capabilities, and the potential advantage of using specialized cloud services, such as a remote storage service offered via the cloud. We advise on the efficient usage of available basic, advanced, or supplemental features.

Enterprises can thereby quickly and securely deploy, run, and manage cloud installations. Our teams also assist tenant application owners with workloads that can be delivered by migrating candidate applications to the cloud. Value can be realized more quickly through repeating processes used successfully in the past, employing automation, and leveraging skilled and experienced personnel. Migration cycle time can be reduced from months to days, with potential ROI in 6 to 18 months. A shared global resource pool across several contracts and agencies can realize increased efficiency using standardized, automated execution, thus leveraging economies of scale. Additional tools aid in cloud migration, such as automation for provisioning, migration, porting, and image import (e.g. the use of Racemi in SoftLayer). These tools simplify the process, give greater control, inform status, improve cycle time, optimize for target platforms, and streamline testing.
IBM Cloud Business Solutions

Our Cloud Business Solutions, as described previously in the General Cloud Models and Enablers section, are offerings that may incorporate advanced Big Data analytics, IBM Research assets, SaaS offerings, Program Products or IBM/partner technology on the front end, with cloud backend support. The following are examples of part of IBM’s Cloud Business Solutions portfolio, which provide customized cloud solutions.

IBM’s Cloud Business Solutions build on “as a Service” models with these characteristics:

- **Repeatable implementations** that are cloud-centric with diverse options, such as leveraging cloud automated provisioning APIs, ready deployment in cloud environments and support for private and public hosted models.

- **Speed to Market:**
  - Rapid, efficient and automated.
  - Optimized for quick adoption, customization and roll out.
  - Reduced TCO, greater economies of scale, and lower costs.
  - Automated tools, run books and processes for speed.

- **Single Tenant:** A separate instance of a software application and supporting infrastructure is used privately by a tenant. Single-tenant architecture is mainly used by enterprises who need a customized approach, either because of their geography or their need of a higher level of security. With single-tenant, each enterprise has a distinct database and system that is either placed on an individual server or segregated using extensive security controls to create a virtual server network.

- **Security** requirements such as authentication, authorization, availability, confidentiality, identity management, integrity, audit, security monitoring, incident response and security policy management.

- **Personalizable** to a single client need, off a common standard image.

- **Integratable:** Value-add through internal and external integration opportunities.

- **OpEx Budgeted:** Offered through cloud business and financial constructs (OpEx).

- **BPaaS (if included):** The client has outsourced both application software and business processing, which can be paid by the month or by the transaction with service level agreements and penalties for customer satisfaction.

Predictive Asset Optimization Module Library

The Predictive Asset Optimization Module Library (PAOML) Cloud Business Solution is a GBS Software Asset Cloud offering designed to demonstrate key analytical insights and recommendations of the PAO Module Library Solution, leveraging Alarm Prediction and Failure Prediction capabilities.

Using predictive and advanced analytics, the Predictive Asset Optimization solution provides a proactive analysis process using equipment and application data from multiple structured, unstructured and streaming data sources to make informed operational, maintenance, repair or component replacement decisions.

Using the PAOML, the Cambridge Canada city government experienced a 50% increase in the number of roads rated “good,” optimized field repair crew workflows and expected elimination of more than $71 million in repair backlog.
Next-Best Action Optimizer

This solution combines in-depth segmentation, multi-channel customer integration and real-time action recommendations to enable an organization to maximize customer lifetime value through targeted up-sell and cross-sell. The IBM Next Best Action Optimizer Cloud Business Solution consists of services to provision, integrate, and provide lifecycle support. User training is provided to ensure effective use.

Counter-Fraud Business Controls

The Counter-Fraud Business Controls Cloud Business Solution is a GBS Software Asset Cloud offering that combines data mining, a process for discovering crucial information hidden in massive quantities of data, with integrated reporting and visualization to clearly represent provider practices. The solution is hosted within an IBM cloud.

The IBM Counter-Fraud solution includes an IBM Research-developed portfolio of assets that use analytics to discover fraud, waste, abuse, and errors in data-intensive industries and functions. These assets analyze an organization's internal data to measure behavior, and then compare the results within specific peer groups to identify anomalies that indicate suspicious activity.

Additional Cloud-Based Solution Examples

IBM Rational Products in the Cloud

IBM Rational products can be utilized in different ways in a cloud environment. One way offered by IBM is the IBM Rational Cloud Hosting and Software-as-a-Service (SaaS), which provides a managed environment of IBM Rational software and systems delivery products. These services are provided through a partnership between IBM and CloudOne, an Advanced IBM Business Partner designed specifically to enable cloud delivery of Rational products. IBM and CloudOne oversee the configuration and implementation of the Rational products and deliver ongoing infrastructure, application and support services remotely. IBM and CloudOne deploy the Rational products in the IBM's SmartCloud for Government (SCG), monitor the system for 24x7 availability, and provide related infrastructure support. Customers access the IBM Rational products through the Internet.

IBM Cloud Commerce

IBM Cloud Commerce provides a set of Smarter Commerce assets that can be deployed in a cloud environment in a short period to dramatically accelerate solution delivery. It includes the following components and features:

- WebSphere Commerce, Sterling OM, Sterling Call Center, IBM Web Analytics, WebSphere Message Broker and third party services.
- Pre-integrated with a rich set of core services.
- High Availability – all production systems have fail-over capability.
- Configured and Performance Tuned.
- Deployed with product data and basic branding in two weeks.
- Development support systems included.
- Private cloud solution deployed quickly using SoftLayer APIs.
- Application management provided by a dedicated global team.
- Standardized patterns to accelerate integration with customer systems.
Smarter Cities on Cloud

IBM Smarter Cities® on Cloud solutions help cities of all sizes leverage information, anticipate problems and coordinate resources to deliver exceptional service to their citizens. By using the cloud to gain immediate access to agency and citywide solutions based on global best practices, cities are able to:

- Make better decisions faster by leveraging information across all city agencies and departments
- Better model and anticipate problems, to minimize the impact of disruptions to citizens
- Accelerate resource coordination in order to respond quickly and effectively to issues

The IBM Intelligent Operations Center (IOC) lies at the heart of IBM Smarter City Solutions on Cloud. The IOC is based on the application of leading practices and solutions that IBM has gleaned from over 2,000 Smarter Cities engagements. Some examples include:

- Criminal acts across a European public rail network are detected dynamically and investigated rapidly using advanced video event correlation and analysis. Investigators can search through millions of recorded events and identify perpetrators in minutes, speeding apprehension and averting future crime.
- Two U.S. cities are now able to issue citywide alerts and coordinate their response to threats and emergencies via a centralized command and operations center capable of consolidating security intelligence and feeds from cameras, sensors and other sources.
- A U.S. state decreased the cost of its security operations by as much as 30 percent while significantly increasing system uptime and availability by outsourcing its security operations and implementing a fully integrated suite of security assessment, monitoring and management services.

Existing IBM-Government Cloud Engagements

IBM has existing cloud engagements across both federal-civilian and defense clients delivering everything from Infrastructure as a Service to delivering applications, such as those managed in our SmartCloud for Government (SCG) hosting environment. We also have clients that are leveraging our software capabilities in their private cloud environments as well as clients who have built clouds based on our strong portfolio of server and storage products. Following are some specific examples:

- **DARPA**: IBM SoftLayer is working with DARPA’s robotics challenge to provide cloud computing resources unmatched by industry alternatives. The OSRF is a non-profit organization, charged with supporting the development, distribution and adoption of open-source software for use in robotics research, education and product development. It relied on SoftLayer Technologies to host the DARPA Virtual Robotics Challenge (VRC). SoftLayer’s uniquely customizable cloud platform allowed challengers to compete from remote locations.

- **GSA**: For GSA TMS (Transportation Management Service), IBM is managing middleware from JDA, Oracle, WebSphere, and Tivoli in IBM’s SCG cloud. This cloud is used to provide the compute, storage and connectivity in a secure cloud environment to support the TMS in an SaaS model. The TMS application enables GSA and the authorized users such as Federal Agencies/Bureaus’ employees and Transportation Service Providers (TSPs) to create, modify, and monitor in support of agency mission programs. IBM has worked with the General Services Administration to move their order management system to our IBM SmartCloud for Government.

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IBM Cloud Computing Vision for Federal Solutions

- **NARA**: NARA's Electronic Records Archives (ERA) program is an implementation of a Big Data solution, providing a way to store and archive huge amounts of data with restricted and public access based on complex access rules. IBM designs, prototypes, implements and sustains a comprehensive integrated development and testing environment in the cloud, which leverages the power of the IBM Rational suite of tools for change management, requirements, defect tracking, and process workflow, all via a cloud consumption and deployment model. These capabilities are supported in environments in the IBM Federal Data Center cloud.

- **The US Navy – Naval Sea Systems Command (NAVSEA)**: The IBM Cloud Managed Services for Government (US Department of Defense), as previously described, supports a NIPRnet-based community cloud, designed to support DISA and FedRAMP compliance (Certification and ATO pending). The solution is based on a highly scalable hybrid cloud technology to support DISA impacts Levels 3 through 5, positioning the NAVSEA to build and deploy new capability, critical to the long term strategy of the US NAVY and DoD. The benefits to the US Navy include future cost sharing and savings associated with expanding the user community for the cloud to all DoD agencies.

- **LAN Airlines**: In this commercial example (with similarities to various agencies), IBM SoftLayer provides LAN Airlines, S.A. (LAN) with a secure, scalable, global cloud infrastructure to run applications critical to LAN Airlines’ business, including the entire flight reservation system. LAN takes advantage of the SoftLayer “bare metal” servers and virtual servers are on the same Virtual Local Area Networks (VLANs) and integrated into a seamless hosting platform, a feature that no other cloud provider offers. To meet its high availability requirements, LAN uses global load balancing for 400 servers across 3 geographically separated SoftLayer data centers. Tapping into the elastic nature of the SoftLayer cloud, LAN Airlines was able to meet, for the first time, the heavy demand surge on Cyber Monday, the busiest online shopping day of the year.

- **Cloud hosting**: In IBM’s FDCs, we provide numerous cloud hosting services in a secure environment for agencies such as CMS, Army, GSA, IRS, NARA, USDA, DOJ, and GSA.

**Future Trends and Directions**

Emerging technologies and advances in cloud services are fast paced and occur throughout the cloud stack. New IaaS, PaaS, and SaaS offerings continue to emerge. We maintain presence, awareness and expertise in the cloud community through our involvement in developing cloud solutions, the Open Source community, and our role as a technology innovator. Our team interacts with our subject matter experts, directly involved in cloud technology innovations, to maintain high levels of expertise in emerging technology. We evaluate these emerging technologies in how they can impact an agency cloud environment and how they can assist the agency in achieving its mission, through cost effective, flexible, and resilient cloud services.

IBM continually enhances our datacenter technology, its automated capabilities, resiliency, capacity and scalability through innovations that meet the ever-changing needs of enterprises whose business-critical operations depend on the cloud. It provides the highest level of life cycle control of features for complex cloud solutions—from deployment to management, refresh, and retirement.

Recent innovations include the development of automated, multi-server deployment and configuration tools for turnkey big data solutions (including open-source MongoDB and Riak). We align the IaaS/PaaS service innovations and changes with improving the user experience, staying competitive in the evolving cloud market, and providing industry leading innovations.

Our SoftLayer cloud services offering has, in the last 3 years, included nearly 100 improvements to the integrated user interface, over 100 cloud service capability additions, over 200 upgrades to existing capabilities, and over 15 market leading innovations. These include automated provisioning of mixed 1G/10G networks; online configuration, automated
deployment, optimized hardware configurations for Big Data Mongo 3.1; and the ability to port from dedicated instances to cloud instances and back.

**Cloud 3.0**

In recent years, we have lived through Cloud 1.0, the investment of centralized computing and storage centers to reduce CapEx. This paradigm is giving way to Cloud 2.0, the maturation of the cloud to facilitate development operations and improve operational agility. On the horizon, we see Cloud 3.0 emerging, where “everything is a service”, and broader business goals can be realized, such as the use of analytics coupled with Big Data to yield cloud-based “systems of insight.”

We observe that cost-effective and scalable compute and storage power drives a vast increase in the amount of data cloud customers can analyze and the capacity to perform ongoing analysis. We see Government executives demanding more real-time analytics to support critical decisions.

The cloud pay-as-you-go pricing model makes complex projects more affordable than using traditional in-house IT capability, enabling more readily accessible scale, technology, flexibility, and elasticity. Agencies can scale cloud storage and processing power up and down as needed for analytics projects rather than investing in adding large amounts of computing and storage capacity.

As a result, we see three trends driving Cloud 3.0’s emergence:

- **Data Volume**: Projections from a variety of sources indicate that there will be on the order of 25 trillion gigabyte of data generated from 2013 to 2020, with the majority of that data residing on the cloud. As different industries have looked at this phenomenon, various partnerships are being formed to take advantage of it.

- **Network Speed**: We observe that network speed is starting to approach IO backplane speed. As that happens, we can disaggregate storage, memory and things such as accelerators, allowing us to provide the next level of capability in supporting future workloads.

- **Security Threats**: Consistent with this era, the operational sophistication of security breaches and attack vectors poses a significant challenge to applications and services hosted on the cloud. This trend coupled with the unprecedented growth of data presents increasing security threats, such as data leakage, cascading failures, availability, vulnerability to external and insider threats, sabotage and malware propagation. We must have the ability to agilely respond, to provide zero day threat vulnerability preparedness, complete situational awareness and level of trust that a 360 degree view of activity and behavior can provide. Internal to the cloud ecosystem, applying advanced insight into growing security threats can only be achieved through real-time monitoring and analytics – taking proactive (preemptive) actions before the actual system failure or vulnerability events happen.

**Cloud 3.0 components**: As we review the requirements of high-value industry solutions, such as the Internet of Things, from Cloud 3.0, we find that there are common patterns leading to components to address them:

- **Modular analytics services**: These could be things like sentiment analysis or social profile extraction core services. These would run on underlying analytics middleware that self-expose as services.

- **Composable systems**: Underlying the Cloud 3.0 system will be models that determine what the underlying requirement of the systems are in order to meet SLAs, and then can automatically configure this through APIs, either to the middle components or systems APIs (in order to configure the underlying physical systems).
IBM Cloud Computing Vision for Federal Solutions

- **Contextual security**: We will have instrumentation to gather data from all levels of the Cloud 3.0 stack. This will enable analysis from the security perspective as well as provide other sorts of runtime data time for feedback to the models to dynamic optimization or model enhancement. Contextual security, enabled by end to end instrumentation, will create greater visibility and use the very features of the cloud to isolate threats.

These services and features will result in high-value Cloud 3.0 systems rooted in “Systems of Insight” providing substantial business transformation and value, enabling rapid creation of industry solutions via analytics patterns.

**Conclusion**

With world-class computing power more affordable than ever, with self-service, personalization and instant access to technology becoming the norm, we can see a shift in expectations regarding cloud computing. Before, the cloud was about running IT more efficiently and at a lower cost. Now, the cloud must drive business value, providing organizations with the ability to experiment, learn and change with unprecedented flexibility and speed.

Cloud-based systems provide a radically different IT model that improves customer acquisition, increases revenue, and improves citizen services, while IT resources are paid for as they are consumed. It allows for more agile business and IT models, which when properly combined, will provide a growth engine for business and agency missions.

IBM meets these needs through a comprehensive set of cloud capabilities including:

- **Technology, tools, and skilled resources to help the Government plan, build and deliver cloud services.** IBM provides clear economic value and helps the client work through the right mix of delivery models and choices by workload to reap the maximum benefit.

- **A proven, common architecture** for the design, build and management of all services across the IBM portfolio, including the cloud environment. The IBM architecture captures the aggregate experience of hundreds of IBM experts in building cloud environments and service-oriented architectures, across all divisions specializing in hardware, software, service management, research and security.

- **Unequalled experience and expertise** with hybrid cloud solutions.

- **Global relevance.** IBM has partners, delivery centers, and a worldwide network of partners in 174 countries. IBM also has the experience of running a globally integrated enterprise and understands what it takes to make a global company run.

- **IT flexibility.** Easy connectivity across a wide infrastructure and ecosystem of partners.

- **Robust and secure cloud solutions**, based on the demanding needs for clear visibility of assets, complex data governance, and security and resilience of the solution.

- **Simplicity of design.** From sourcing to usage to maintenance, IBM Cloud solutions are designed to be simple, intuitive and based on how people actually work.

- **Open standards.** IBM has taken a leadership role in developing standards for cloud computing built on current architecture, industry and open standards, including SOA, assuring consistency and compatibility across all cloud platforms.

IBM’s vision, supported by its cloud solutions, enable the Government to execute business processes, analytics and applications as a service, realizing cloud benefits through faster deployment. These solutions enable agencies to reduce risk and capital investment, as well as the burden on IT resources, with instant and ongoing scalability to keep pace with expanding requirements.
For more information

To learn more about the IBM Cloud Computing portfolio, please contact your IBM representative or IBM Business Partner, or visit: www.ibm.com/cloud-computing/us/en/


Additionally, IBM Global Financing can help you acquire the IT solutions that your business needs in the most cost-effective and strategic way possible. We'll partner with credit-qualified clients to customize an IT financing solution to suit your business goals, enable effective cash management, and improve your total cost of ownership. IBM Global Financing is your smartest choice to fund critical IT investments and propel your business forward. For more information, visit: ibm.com/financing.

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