



# The Hybrid Cloud: Bringing Cloud-Based IT Services to State Government

October 4, 2009

Prepared By: Robert Woolley and David Fletcher

## Introduction

Provisioning Information Technology (IT) services to enterprises has traditionally been burdened with complexity for customers and characterized by many complex IT platform and service implementations. This is not a viable approach to IT service provisioning for results-focused business customers. The concept of a computing cloud has the potential to simplify and add value in some new and useful ways.

NIST<sup>1</sup> has defined Cloud computing 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.” The State of Utah will use this definition as a starting point.

Cloud environments are best viewed from a user perspective as opposed to more complex internal customer-technology perspectives. A cloud environment has to provide advantages to the owners and users of the resource.

Characteristics of the Utah cloud service offering include:

- Be located off-site in State data centers, or offered through third-party service providers
- Be solution-based and solution-packaged, meaning that all supporting elements for a given cloud solution are bundled and managed by the service provider
- Be accessed via the Internet, using standard TCP/IP protocols, with a Web browser as its primary user interface, while offering its main system interfaces via Web services APIs
- Require minimal IT skills to order and implement
- Be available in a way that supports self-provisioning and self-service requesting, with 24/7 availability for order placement and near real-time deployment
- Offer dynamic and fine-grained scalability

---

<sup>1</sup> Mell, Peter and Tim Grance, *Draft NIST Working Definition of Cloud Computing*, NIST, August 21, 2009  
<http://docs.google.com/Doc?docid=0ASrFhZPGT2ahZGNobWYzYnhfNGQ1a3d0cmNo&hl=en>

- Offer pricing options which also are fine-grained, based on usage (capable of being measured and metered as necessary)
- Use shared resources and common versions (one-to-many), with any customization (which should be minimal) built around the shared services.

Cloud software leverages the cloud model by being service-oriented, with a focus on statelessness, loose application coupling, modularity, and practical semantic interoperability. Services are deployed using Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS).

NIST<sup>2</sup> has suggested four fundamental deployment models for cloud services:

- **Private cloud.** *The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third-party and may exist on-premise or off-premise.*
- **Community cloud.** *The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be managed by the organizations or a third party and may exist on-premise or off-premise.*
- **Public cloud.** *The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.*
- **Hybrid cloud.** *The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds).*

## Vision

It is the desire of the State to develop a Cloud environment that leverages internally-hosted services with specialized access and security requirements with public services that add to or replace existing State infrastructure services. When the State of Utah Cloud services vision is realized, users will be able to:

- Use on-demand self-service and provision-computing capabilities, such as hosting and network storage, as needed, without requiring human interaction with each service's provider.
- Access services over the network and through standard mechanisms that promote use by heterogeneous thin or thick client platforms.

---

<sup>2</sup> *Ibid.*

- Use resource-pooling to serve multiple users using a multi-tenant shared model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand.
- Use services with location-independence enabled, in that the customer generally has no control or knowledge over the exact location of the provided resources.
- Use service resources at more abstract levels such as storage, backup services, processing, memory, network bandwidth, and virtual machines.
- Be able to leverage capabilities that can be rapidly and elastically provisioned to scale out, and rapidly released to scale in.
- Use capabilities for provisioning that often appear to be unlimited and can be purchased in any quantity at any time.
- Report on resource-usage that is monitored, controlled, and reported providing transparency for both the provider and user of the utilized service.
- Use appropriate implementation of security and privacy that meets State and Federal requirements.

The State of Utah Computing initiative is a services-oriented approach, where common infrastructure, information, and solutions can be shared and reused across participating Utah Government agencies. The overall objective is to create a more agile State enterprise where services can be reused and provisioned on demand to meet agency needs as cost effectively as possible.

### Implementation

The DTS Cloud is a hybrid approach to dynamic-provisioning of services for current and future customers of the Department of Technology Services. It consists of services that exist both within the DTS private cloud, a platform built on a redundant, virtualized hosting environment in the DTS Salt Lake and Richfield data centers, as well as global services provided through the DTS virtual provisioning service. Implementation presumes a framework approach similar to that suggested in the GSA Statement of Work<sup>3</sup> that includes:

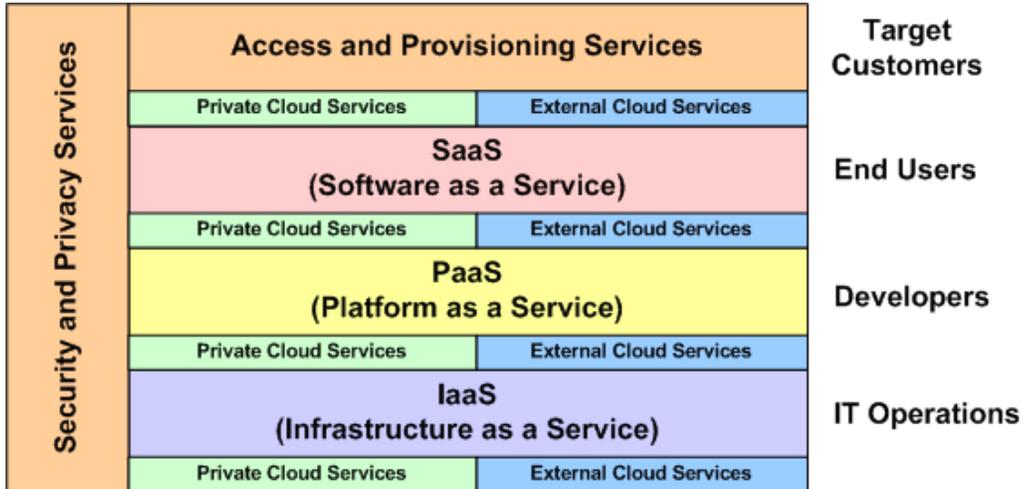
- Cloud Service Delivery Capabilities: Core capabilities required to deliver Cloud Services
- Cloud Services: Services delivered by the Cloud

---

<sup>3</sup> *IaaS RFQ BSA Statement of Work*, General Services Administration, July 30, 2009.

- Cloud User Tools: Tools or capabilities that enable users to procure, manage, and use the Cloud services

Figure 1 illustrates the basic components of the State of Utah hybrid cloud technology stack envisioned by the Department of Technology Services (DTS).



**Figure 1. Cloud Services Technology Stack with Targeted Customers**

- Access and Provisioning Services provide identity and access services, service provisioning, service level specification, and monitoring and billing services to end user customers.
- Security and privacy services are provided at appropriate levels in both private and external cloud environments consistent with risk and legal requirements such as HIPAA.
- Software as a Service (SaaS) is a model of software deployment where DTS, the service provider, provides an application to customers for use as a service on demand. Services may be hosted internally or externally.
- Platform as a service (PaaS) is the delivery of a computing platform and solution stack as a service.
- Infrastructure as a Service (IaaS) is the delivery of computer infrastructure (typically a platform-virtualization environment) as a service.

The hybrid approach combining private and external cloud services allows DTS to internally host and provision services that are unique to the State and which may have specialized security requirements and to leverage external cloud provider services, as a single customer view to IT services.

## Integrating Service Catalogs

The hybrid cloud offers opportunities to take many heretofore siloed DTS services and expose them within the private cloud. Integrating external or public cloud services with the private cloud provides a single view of the IT Service Catalog. The end-user gets a more holistic and satisfying view of IT service offerings.

## Summary and Conclusions

Implementation of the DTS Cloud environment requires a number of analysis and implementation thresholds. Among them are:

- Virtualize existing server platforms is basic to private cloud implementation.
- Consolidate and standardize of application and database environments.
- Instrumentation, metrics, billing methodologies, and service levels for services that are provisioned in the cloud.
- Service catalog definition for private and externally-provisioned cloud services.
- Simplify and provide electronic and highly automated end-user provisioning for private and external cloud-service offerings.
- Establish communication and marketing plans for potential cloud services customers and DTS technical staff.
- Develop standards to support consistent delivery of cloud services including considerations such as:
  - Cloud-storage interface, control, and management APIs
  - Software-as-a-Service (SaaS) data exchange and interoperability
  - Identity management and authentication
  - SLAs, performance monitoring, billing, and metrics
  - Infrastructure-as-a-Service (IaaS) control and management APIs
  - Platform-as-a-Service (PaaS) control and management APIs
  - Cloud security and privacy services

Building a private cloud computing environment is not just about technology. The hybrid approach between private and external cloud providers brings together the best of both worlds. It also changes management processes, organization, culture, and relationships with agency business customers. These changes will make it easier for DTS and its customers to make good cloud-sourcing decisions and transitions in the future.

From an outcome perspective, the DTS hybrid cloud will provide customers with a simple and cost-effective way to provision IT services, irrespective of where the services are hosted or provisioned. The hybrid cloud enables standardization at new levels which reduces IT complexity, and in the end provides a more reliable and feature rich IT service resource for customers.