

**2011 NASCIO Recognition Award Nomination
MiCloud Automated Hosting Service**

Section A - Cover Page

Title: MiCloud Automated Hosting Service
Category: Fast Track Solutions
State: Michigan

Contact: Bob McDonough, Lead Cloud Architect
Office of Enterprise Architecture
Department of Technology, Management and Budget (DTMB)
State of Michigan (SOM)
mcdonoughb@mi.gov
517-719-1884

Team: Bob McDonough, MiCloud Program Manager
Jason Weaver, DTMB Virtualization Center of Excellence
Eric Haas, DTMB Virtualization Center of Excellence
Sunil Varghese, DTMB Datacenter Services
Chris Deemer, DTMB Telecom
Jeff Cherng, DTMB Agency Services MDOT

Executive Sponsor: Dan Lohrmann, DTMB Deputy Director, CTO

Section B - Executive Summary

In late 2010, Michigan technology executives faced an important crossroads. Many of our services were too expensive, and we were too slow to deliver. Our Governor-elect Rick Snyder promised to “reinvent” Michigan, emphasizing agile technology as a key enabler. Although SOM IT service quality, performance and security were excellent, it was clear that bold new action was required.

Fiscal pressures and emerging options resulted in a sustained demand for fast-track solutions. Michigan’s goal: *Develop a rapid service transformation capability to address a broad range of fast-track issues, then use this capability to reinvent core IT services in multiple jurisdictions in Michigan.* Cloud computing offered savings, pervasive supplier advocacy, promising federal models and new solutions.

Everyone talks about “The Cloud.” Michigan has captured the numerous benefits of cloud computing, rapidly transforming the way we deliver IT services to government. When our clients demanded “more for less”, we delivered MiCloud - a fully automated self-service cloud platform on a fast track in early 2011.

MiCloud results have exceeded our customer expectations and offer:

- Web-based self-service provisioning that delivers Infrastructure as a Service (IaaS) with a variety of associated offerings.
- Virtual machines (VMs) in less than 30 minutes.
- A secure, compliant IT service that meets deadlines within financial constraints.
- Business value exceeding public cloud offerings by leveraging fiber backbone speeds and co-location of data with compute in the same facility.

Our MiCloud team delivered cloud storage in 2010. Next the team was challenged to transform the delivery of new servers environments. Customers could not wait weeks for servers and pondered non-secure options that lacked key protections.

The MiCloud project approach was created to drive agency business transformation (ABT) projects. Commercial solutions for delivering cloud hosting were examined, but none met the requirements. Existing DTMB virtual server farms were leveraged. The Automated Hosting (AH) service transformation became the catalyst for all fast-track ABT projects, by reducing uncertainty, complexity, dependency and risk.

The AH approach improved DTMB service delivery beyond application hosting, by automating routine, costly and error-prone manual tasks. The AH solution enables multi-sourcing and rapid, low-cost re-sourcing, while preventing vendor lock-in.

“Cloud computing is not something that you buy. Cloud computing is something that you do.” The team did not request capital expenditures. AH breaks barriers to consolidation, standardization, virtualization and optimization through innovation. AH delivered immediate budget relief with an enterprise service that supports legacy application modernization, consolidation and infrastructure optimization.

All state agencies are beneficiaries. SOM decision makers gain the freedom to take risks and try new strategies, to succeed or fail quickly, then move on. Organizations that adopt the AH project approach and/or the AH solution will replicate Michigan’s success. Citizens and businesses enjoy service innovations sooner and appreciate the value for money delivered as tax payers.

The AH service exceeded all performance targets. The light-weight solution delivers VMs 99.9% faster that cost 75% less to operate. Total project cost = \$118,329. Project payback occurs in September 2011. By December, ROI = 248%.

These outstanding results transform alternatives analysis efforts and break dependencies between production support and development. This agile capability enables SOM decision makers to accelerate innovation in government service delivery.

Section C - Business Problem & Solution

Issue and Problem Context: In late 2010, DTMB IT executives faced some harsh realities as Governor-elect Rick Snyder prepared to take office. A benchmark study showed that many of our services were too expensive, and our clients felt we were too slow to deliver. Although service quality, performance and security remained high, it was clear that bold action was required. Our new goal: *Rapidly create a service transformation capability, then use this capability to transform core IT services. Demonstrate that DTMB is competitive in all aspects of service delivery, including security, quality, speed to deliver and cost.* Our new business leadership demanded rapid agency business transformation (ABT). DTMB must become the key enabler of that transformation, or dwindle to irrelevance.

Fearing the “IT shop” may not deliver, some agencies were issuing Requests for Proposals (RFPs) for externally provided IT services. Agencies feared that DTMB IT services would be delivered too slowly to meet critical deadlines. Financial mandates from executives drove program managers to select low-cost providers, despite the absence of key contract terms and conditions, the lack of auditable controls and serious security issues. The integration of a growing number of immature external service providers was straining Michigan’s ability to secure information and manage compliance (PII, PCI, HIPAA, e-Discovery, etc). Many system-to-system interfaces from poorly governed vendor environments were required. DTMB was responsible for securing the SOM IT environment, yet had diminishing control over an increasingly fuzzy perimeter.

Strategy: We started by surveying the innovative opportunities that could be rapidly deployed to solve immediate business needs. This process for rapid deployment and enterprise architecture improvement led to the decision to push forward with cloud computing technologies. Michigan’s cloud computing strategy, the first published state government cloud computing strategy in the nation, focused on leveraging emerging cloud computing technologies and business models to deliver dramatic increases in IT agility. The resulting program was dubbed, “MiCloud”, Michigan’s cloud computing service program. MiCloud presented an excellent opportunity to simultaneously define a reusable fast-track capability, and to demonstrate that capability by rapidly transforming our most fundamental IT service: application hosting. The MiCloud Automated Hosting (AH) project demonstrated a fast-track project approach and delivered a critical fast-track project catalyst: a fully automated, self-service cloud computing platform.

Project Timeframe: The project started October 1st, 2010. The project ended and full AH production began May 1st, 2011. The service owner (the DTMB Virtual Center of Excellence) conducted roadshows to educate IT teams in May. Roadshows to educate agency business owners are occurring in June.

Problem: The AH service was required to enable rapid business process transformation by dramatically lowering the agency investment risk, both in time and money, of pursuing new business approaches. The project proposed to transform the existing, manually-intensive DTMB hosting service by creating a second, fully automated service channel.

Selection: A thorough cost/capability survey of available public cloud hosting options was created. Several were selected as *reference services*, that is, commercially successful services to be emulated, chief among these: Amazon EC2. None of the services satisfied the AH requirements. All commercially available solutions for delivering private cloud hosting were examined, but none met the requirements better than a simple, scripted solution using the tools SOM already owned.

Barriers, Challenges, Opportunities: Available commercial solutions were

immature, overly complex and very costly from a TCO perspective. It became clear that negotiating acceptable terms and conditions would negate the cost and speed benefits of public providers. New private cloud solutions required a major up-front investment. Any option with a payback in excess of one year was discarded, acknowledging the probability of on-going disruptive innovations and continued cloud market repositioning.

An evaluation of the maturity of virtualization technology APIs such as VMware's ESX and scripting languages such as Microsoft PowerShell (PS) yielded impressive results. There was no cost to acquire these tools. The project team could deliver a simple, powerful, fully-automated AH solution and eliminate procurement tasks.

A significant barrier for clients wishing to move on consolidation, standardization, virtualization and transformation initiatives is fear. Clients fear that, if they agree to try and there are problems, IT won't be able to put systems back precisely as they were. Agencies have experienced serious consequences from blown changes. Backups alone do not enable consistently reliable change rollbacks.

Solution: The AH service is a paradigm breaker. The hosting service is delivered in response to web-based self-service requests. The solution delivers VMs in less than 30 minutes. The AH service is feature and cost competitive with leading public cloud IaaS vendors such as Amazon EC2 and Rackspace. It enables agencies to choose a secure, compliant IT service and still meet critical deadlines within financial constraints.

The AH solution is an in-house developed, PS / VMware PowerCLI scripted automation engine for virtual host provisioning and management. The AH solution delivers IaaS, as defined by NIST. There are no up-front costs to the agency and no data in-out charges. The AH capability to inactivate a server and retain the image for a nominal fee, critical to our clients, is not available in many public offerings.

AH is not exposed to internet-based threats, and data travels at intranet speeds, many times faster than any internet-based provider. For speed and data security, AH value exceeds public cloud offerings for SOM applications.

Solution Architecture: The AH solution has the following architecture:

- A browser-based, shared *service interface (SI)* and orchestration layer
- A provider-specific automated *provisioning layer (PL)*
- A shared *metrics and billing (MB)* layer

SI: Agency IT support staff request server provisioning, restarts, rebuilds, activation, deactivation and deletion, as well as manage agency-specific server templates, through the SI web interface. SI is loosely coupled to PL via web services.

PL: AH supports multiple providers for a given service. Currently, AH does not leverage a hybrid partner. Simple provisioning scripts for each provider API are integrated with SI and MB via web services.

MB: MB is loosely coupled to PL via web services. MB contains the CMDB and supports gathering metrics and performing automated billing for multi-sourced services.

Section D - Significance of the Project

Scope: The MiCloud project approach is applicable to service transformation projects. The scope of the first use was the transformation of the DTMB hosting service.

The AH solution satisfies the same use cases as a traditional hosting service, plus three new use cases (see *Qualitative outcomes*, section E). These support fast-track ABT projects by reducing uncertainty, complexity, dependency and risk.

Impact of the project: The AH project delivered the advantages of cloud computing as a catalyst to ABT. Innovators can implement the governor's priorities more quickly and at a lower cost. Shared services can start small and scale only as consumers adopt the service. The ability to build capacity in minutes is revolutionary.

Improved government operations: The AH project improved DTMB service delivery beyond application hosting. By extracting routine manual tasks from the work queues, technicians are able to focus more attention on the delivery of more complex and non-cloud services. (See *Measurable operational benefits* in Section E.)

Manual processes are more costly and more error prone. The AH project built integrations to the CMDB and billing systems, creating hooks that allow even non-MiCloud services to be automated and billed electronically.

Innovation of the approach: The innovative AH solution is designed to enable multi-sourcing and rapid, low-cost re-sourcing. AH employs vendor-agnostic server images and loose coupling web services to prevent vendor lock-in. The unique design enables a solution to migrate between providers throughout a system's lifecycle.

The design starts with powerful precept: "Cloud computing is not something that you *buy*. Cloud computing is something that you *do*." The AH solution *did not require a capital expenditure*. AH leverages prior investments in virtualization. The entire solution consists of seven simple PS scripts and three simple web pages. Yet for SOM applications, AH delivers a service that is superior to Amazon EC2 in the dimensions of security and performance. AH is directly comparable with Amazon EC2 in the dimensions of quality, speed to deliver and cost.

NASCIO's State CIO Priorities: Use Case 3 (see *Qualitative outcomes*, section E) breaks barriers to consolidation, standardization, virtualization and optimization. AH delivers immediate budget relief. AH is an enterprise cloud computing service.

Use Case 1 (see *Qualitative outcomes*, section E) supports legacy application modernization by enabling rapid, low-cost trials of alternatives. Server consolidation and infrastructure optimization is accelerated, as well. AH servers can be built small initially and then, after an initial trial, the server can be rebuilt with more vCPUs and vRAM in minutes. Before AH, servers were resource over-allocated based on conservative assumptions. AH enables full optimization and self-service adjustments to compute resources, including for expected demand spikes or lulls.

Governor's Priorities: *Budget:* AH helps deliver on Governor Snyder's announced budget priorities by enabling agile business process changes while lowering cost. *Accountability:* The AH automation engine was also leveraged to rapidly deliver an enterprise-wide score card solution in support of his government accountability goals.

SOM ICT Strategic Priorities: *Access:* MiCloud AH enabled the acceleration of the SOM mobile applications strategy timeline. *Service:* AH is the archetype of an efficient, effective enterprise technology service. *Management and Infrastructure:* AH standardizes operations. Security is strengthened by reducing the administrator access to servers and by achieving the benefits of cloud computing without exposing SOM workloads to internet-based threats. *Great Workplace:* The automation of routine work allows staff to focus on satisfying tasks that drive retention. *Cross-boundary Solutions:* The project approach and solution are designed to be leveraged. *Innovation and Transformation:* This is the primary focus of MiCloud AH.

Beneficiaries of the project: All state agencies are direct beneficiaries of the fast-track approach and resulting enterprise service. Agency business owners are empowered to rapidly transform services. Decision makers gain freedom of action, to take risks and try new business strategies, to succeed or fail quickly, then move on.

AH investments pay dividends for the service sector, other public sector and cross-boundary organizations that adopt the project approach and/or the open-sourced AH solution. Citizens and businesses that rely on SOM services receive innovative improvements sooner, and appreciate the value for money delivered as tax payers.

Leverage / Transferability: Large local units of government (LUGs), other states and federal agencies can benefit immediately from the MiCloud project approach. Those organizations that currently provide virtual servers can benefit immediately from adopting the AH solution. Collaboration interest among NASCIO members persuaded IT executives to open-source AH by December.

Interaction with smaller LUGs (Nov 2010) showed a strong interest in leveraging a secure, low-cost hosting cloud service provided by the SOM. Discussions with LUGs regarding providing this service in the next 6 months began in May, 2011.

Section E - Benefits of the Project

Benefits to stakeholders: e-Michigan used AH to rapidly create a load-testing platform in support of their government transparency and metrics portal. The Department of Community Health designated AH to jump start their Health Information Network - Master Patient Index project. The Michigan Department of Transportation (MDOT) used AH to create customized server images that enabled rapid creation of servers pre-configured with MDOT applications. Treasury used the AH solution to test critical software upgrades without disrupting on-going priority projects.

The enterprise benefits. AH is simple and introduces no new technologies into the ICT environment. Complexity imposes risk and cost on the enterprise.

Measurable operational benefits: The MiCloud AH project dramatically demonstrated the power of the MiCloud project approach for delivering fast-track service transformations, as no new SOM IT service had ever gone from conception to operation in 7 months before. The resulting AH service exceeded all service performance impact targets and was delivered both on-time and on-budget.

Target service measure	Baseline	MiCloud AH	% Diff*
Time to deliver a virtual server	6+ weeks	17 minutes	99.9%
Cost to operate a server that is used daily - includes O/S license, 80GB O/S + data storage	\$970/month	Active: \$8/day (\$240/month)	75.3%
Cost to operate a rarely-used server - e.g. a dev VM for an application not in active development	\$970/month	Inactive: \$1/day (\$30/month)	97.0%
Cost to store an agency server template	new capability	\$1/day	--

* %Diff = (MiCloud AH ÷ Baseline) x 100 %

The AH service is conservatively projected to reach 10% of all SOM virtual servers (90 AH servers) by the end of December, 2011.

Savings \$* †	May 11	Jun 11	Jul 11	Aug 11	Sep 11	Oct 11	Nov 11	Dec 11
Monthly \$*	8,030	16,060	24,090	32,850	40,880	48,910	56,940	65,700
Accumulated \$**	8,030	24,090	48,180	81,030	121,910	170,820	227,760	293,460

* Monthly \$ = # of AH servers x \$730 reduced IT billing to agencies per server.

** Accumulated \$ = running sum (Monthly \$). † July-December 2011 projected.

Payback and ROI: No new infrastructure, software or contracted services were procured. The solution is extremely light-weight, consuming only spare cycles on previously operating servers. Total project staff hours = sum (staff member hours) = 1,580. Total project cost = sum (staff member hours x fully loaded hourly cost for each staff member) = \$118,329. All operating costs are recovered in the AH service rates.

Project payback occurs in September 2011. By December, after 8 months of full production, ROI = (Accumulated \$ ÷ Total project cost) x 100 % = 248% and climbing.

Qualitative outcomes: The automated AH delivery process corrects a structural flaw in DTMB's hosting rates. The manual server delivery effort occurs prior to the start

of billing for a server. These hours went unbilled, inflating DTMB's overhead costs.

Improved customer satisfaction and higher regard for DTMB as a world-class IT service provider has been observed but not measured.

Interviews with entry-level IT candidates have consistently revealed a strong preference for meaningful, challenging work. Today's college graduates are not seeking a job, they are seeking a mission. Automating routine work, adopting leading edge technologies and emphasizing socially meaningful transformation has a positive impact on SOM's retention and recruiting messaging.

The AH team found that 25% of delivered servers had at least one manual configuration error that impacted operation. MiCloud AH eliminates these errors, positively impacting time to deliver, preventing re-work and enhancing IT's reputation.

Use Case 1, Rapid Alternative Demonstration: Agency decision makers needed to understand the benefits and risks of attempting system transformations (e.g. swap a costly application for open-source, or enable a new business process flow).

There is no form of IT analysis that is as powerful as simply giving it a try. Alternatives analysis predicts. Increased analysis effort produces diminishing returns beyond a probability plateau. AH enables low-cost, limited trials to *demonstrate* the result. Increased effort continues to reduce uncertainty proportionally.

Use Case 2, Production Dependency Breaker: Suppose a development team is 6 weeks into a 12 week project in support of an ABT. They are creating v2 of their software on the development servers. The latest release of v2 is being reviewed on the test/QA servers. Production servers are running v1. Then, the support team detects a problem with v1 that will cause a critical failure within one week.

Before AH, work on v2 would be halted, so that the support team could use the development and test/QA servers to correct v1. The ABT would be delayed until v1 was verified fixed. In a complex project, this delay could have cascading negative impacts.

AH breaks the dependency between production support and development. In the example, work on v2 would continue without interruption. The support team would use AH to create a second set of development and test/QA servers to correct v1.

Use Case 3, Best practice drives culture shift: Using AH, IT can guarantee that any AH server changed in support of ABT can be reliably returned to the pre-change state. AH allows each server to resume operation at the next instruction, as if the change had never happened. *Best-practice automated rollbacks create a safety net for client decision makers that encourages exploration and experimentation.*

Fast-track Approach: The approach reduces project uncertainty, complexity and dependency. The SOM Project Management Methodology, Solutions Engineering Methodology, Enterprise Security Risk Mitigation and Enterprise Architecture Solution Assessment processes ensure best practices.

The approach recognizes that a demand-and-offer relationship exists between agency executives and the IT organization. Client demands become urgent service and performance targets, requiring a rapidly accelerated implementation calendar. Project objectives are framed in terms of collective survival. Rapid forward momentum is sustained, as all stakeholders embrace the fast-track culture, values and processes.

Solution elements must be well-known by the available resources. Tasks must be simple to estimate, execute and measure. Work products must be simple to objectively validate. External dependencies are resolved by developing an alternative or absorbing the dependency. Strong alternatives analysis and development skills are a critical success factor. A fundamental belief must be engendered in the project team: *If it is hard, we are doing it wrong. There is a simple way to do anything, and we can find it.*