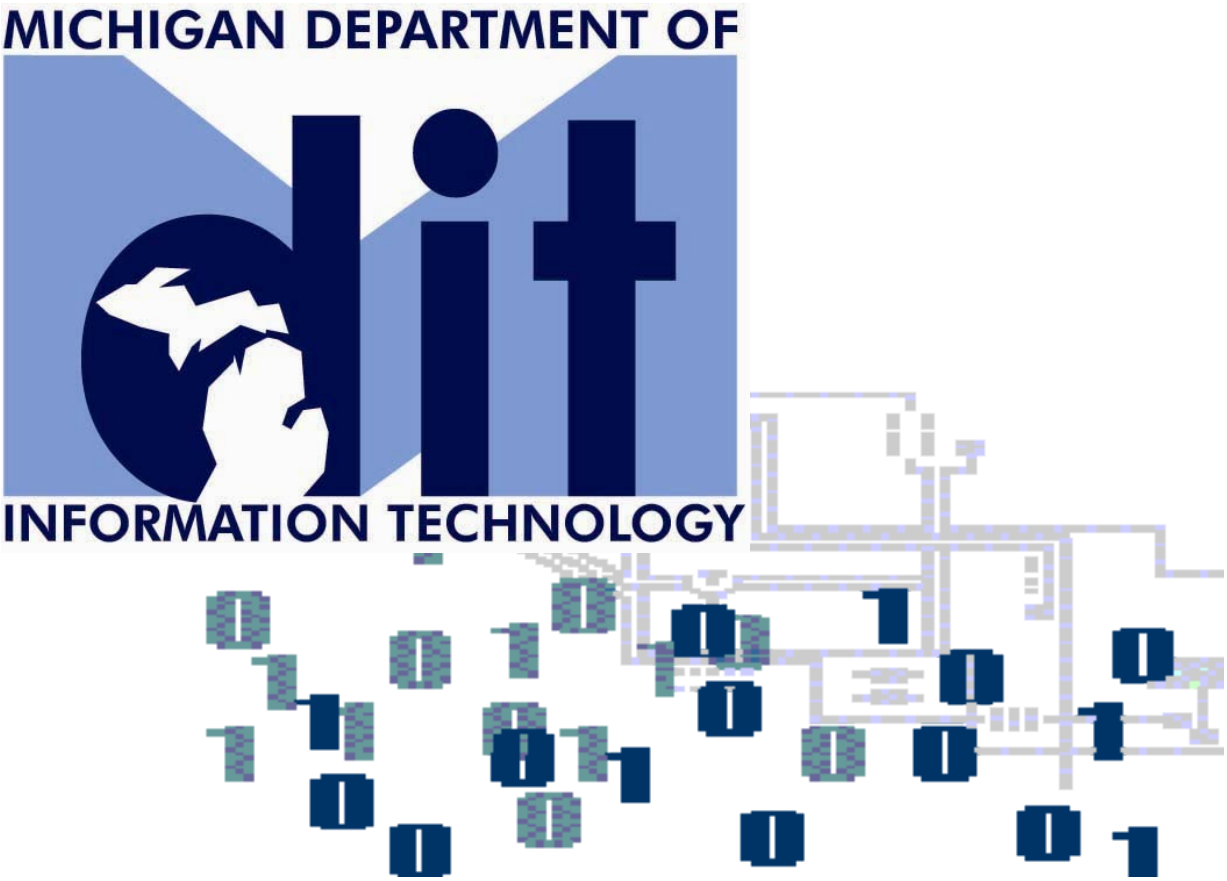

Enterprise Storage, Backup & Recovery

State of Michigan

Nominating Category: Business Continuity and Disaster Recovery

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Section B: Executive Summary

Storage and Backups, there are fewer projects that excite a CIO less and yet these two components are the basis for nearly every disaster recovery plan and business continuity initiative ever conceived. It's not sexy, shiny or alluring, but the undeniable truth is that Michigan would not be where we are today without this service. Storage and Backups support the foundation of every IT organization on the planet by ensuring that primary data resources are continually intact, secure, and available to serve its citizens' needs.

Using a combination of process, governance, and cutting edge solutions Michigan has reaped the rewards and cost benefits of a statewide storage and backup service. Our enterprise storage environment was built in 2001 and consisted of only 300 hosts and 13TB. Since that time, this installation base has grown to more than 2.4 Petabytes and now houses data from every state agency across our three main hosting centers. A completely synchronous solution has been built and recovery of that data is measured in hours and minutes rather than weeks. The server population being backed up by the enterprise grew from 300 to a current count of 1,600 servers of various OS platforms.

The storage and recovery solutions have made initiatives like e-mail standardization, a common statewide office platform, and data center consolidation a reality. State teams have developed a full-scale Information Lifecycle Management (ILM) strategy that includes repeatable processes and maintained service levels with staffing ratios well below private sector benchmarks. Our enterprise SAN has been extended as far as Maryland to enable virtual development teams and reduce technology project costs.

But the journey to where we are now was a rocky road. We learned our lessons the hard way. In a rush to complete consolidation, we discovered the limits of our long touted infrastructure were being pushed beyond capacity. Wholesale consolidation efforts strained our technical solutions and the employees that support our systems day in and day out.

In response to these pressures and to accommodate the ever increasing data protection needs of the state's data, Michigan took a radically different approach to providing the vital service of backup and recovery by providing primary administrative project oversight and blending the use of offsite and onsite contracted technical staff in a tightly-woven business to government technical support process. Using a true partnership model, Michigan has been able to provide a repeatable fully managed, 7 x 24 x 365, Server Backup Services (SBS).

In the end, Michigan has proven that the best approach is to go back to the basic foundations of support service, and do it well, and utilize a Shared Enterprise Storage and Backup approach. The underlying benefits to the organization include the allowance for standardization of backup and recovery functions, tiered storage protection of citizen data classified based on Recovery Time Objectives (RTO)/Recovery Point Objectives (RPO), and a centralized robust storage environment using the foundation for providing other enterprise services to ensure the protection of state government data now and well into the future.

Section C: The Business Problem & Solution

Before 2001 the successful mainframe consolidation pointed out a glaring risk with open systems and their disaster recovery potential. Since its inception in 2001, the storage and backup infrastructure was built to provide centralized storage services statewide and decrease the risk of data loss to the state's open systems. After a multi-state blackout in 2003, Governor Granholm refocused state agencies on protecting the critical systems throughout the state. The Michigan Department of Information Technology (MDIT) began to examine its risks and turned its attention to full scale data center consolidation. Almost immediately the consolidation was derailed when it was discovered that many of the state's most critical applications housed outside of the hosting centers had no disaster recovery platforms. Moving those systems was a risky proposition and required a luxury our agencies could not afford…downtime. Backing up the entire system to tape could take one-three days, and in many cases there just was not a processing window to accommodate the moves. Migrations proceeded at non-critical sites and with more and more data being stored centrally the pressure on the backup team began to increase.

Servers were brought in from across the state; older, less reliable storage and backup solutions were set aside; and the demand for moving to the consolidated platform increased. As servers in the hosting centers were refreshed they were required to use enterprise SAN and backup systems. Within months our storage teams were overloaded with requests and the backup solution was strained beyond its capacity. Backups began to fail and technical teams were forced to "juggle failures" to ensure the same systems never failed twice in the same week. The situation peaked when data from a critical application in the Department of Community Health was lost and had to be recovered manually.

Now the supreme challenge was to keep the daily operations running at acceptable service levels, keep pace with the growing demands of consolidation, and architect a new solution that was flexible and (above all) scalable.

The Solution – A comprehensive framework for Storage, Backup and Recovery

The project approach taken by MDIT teams to remediate the issues ensured that the situation was fully documented, future load was estimated and that those requirements were passed on to the technical teams architecting solutions. This planning approach provided a model of success that is used for capacity planning and requirements gathering for other rated services.

Storage Solution Flexibility: (Jan 2004-July 2006) The MDIT's SAN solution was state of the art, but, built solely to deliver high-availability to the most critical of systems. It was simply too costly for the vast majority of the state's storage needs. The State of Michigan realized that there had to be a better way to deliver a suite of services in a centralized manner. An ILM strategy was developed and Michigan became an early adopter of a three-tier storage model.

High-end Storage **–** This storage is meant for the most critical applications and data where the loss of that function would endanger human life or severely deplete an absolutely essential state service. Disk storage is mirrored, striped and enables remote synchronous

replication. This capability allows complete and immediate recovery of critical systems from every possible outage from a single user mistyping input to the catastrophic loss of an entire data center. Examples of systems on this tier include Michigan's Child Support Enforcement, the Department of State Police's Law Enforcement Information Network, Department of Corrections' offender tracking systems, payroll, disaster coordination systems, and Department of Treasury's tax collection systems.

Mid-tier Storage **–** This tier is targeted at systems and applications that are important to state services but do not require the same level of uptime. It allows the services to enjoy redundancy within the solution but avoid the expense of a complete mirror of the data utilizing RAID 5 technology and the latest fiber channel technology for maximum throughput. Data is striped across multiple disks and changes can be "rebuilt" if a serious problem develops. Recovery in the event of a disaster takes longer but is still accomplished within an acceptable window. Some examples of applications include test and development servers, consolidated files services (that have documents and spreadsheets from across the state), project tracking systems, and remote office data. Primary agencies using mid-tier storage include the Department of Environmental Quality's data tracking systems, Department of Education's student assessment data, Unemployment Agency's internet claims system, and MDIT's internal support data.

Low-end Storage **–** This storage is meant for high volume data that is archived or rarely accessed. This storage includes access to non-critical data, archiving and services such as near-line Virtual Tape Libraries (VTL) and Content Addressable Storage (CAS). This tier was architected not only to offer a lower cost alternative, but also to alleviate backup volume issues and provide a standard to speed backups and reduce recovery times.

Classifying data into tiers addressed multiple shortcomings in our enterprise storage service solutions. It accelerated growth, lowered cost, and removed inefficient utilization of expensive technologies. Tiered storage has paved the way for storage virtualization and introduced more automated, policy based data migrations within the tiers. ILM implementation resulted in an exponential increase demand for all tiers and changes were implemented to scale the architecture. The SAN fabric and switch gear was upgraded and improved throughput was provided throughout all three hosting centers. In addition to capacity upgrades, tools were implemented to allocate, manage and bill storage across the state's 19 agencies.

By 2005, MDIT technical teams had developed a process to extend the SAN and provide a full system copy of almost any systems in a matter of hours. The final barrier to consolidation had been overcome and the pace of migrations increased (30 data centers were closed in 2006-2008). The corresponding affect of the successful storage approach was that it dramatically increased the demands on the already struggling backup solutions.

A New Dawn for Backup and Recovery: (Jan 2006 – Dec 2007) By early summer 2007, the backlog of the new installs, modifications to the current backup configurations and a less than satisfactory backup success rate (in low 60s and 70s) were becoming a bottleneck in MDIT's ability to meet project deployment time-lines. A new approach was taken and an RFP was issued to examine the state's options for a solution given the new load and systems requirements. After a period of intense technical scrutiny, the Veritas NetBackup

environment was chosen as the technology best suited to our urgent scalability needs and varied technical environment. The RFP also asked for quotes for a managed backup service that would extend Michigan's ability to monitor and maintain backup operations 24x7x365. Contract staff worked side by side with state staff combining off-site monitoring with on-site issue resolution and direct state oversight.

Phase 1 – Digging out of the Support Hole

Capacity was added to the enterprise solution, new technologies were introduced (VTL's, etc.) and several single points of failure identified in the architectural review were eliminated. Support processes changed as well. Work queue requests were prioritized by MDIT managers each week to ensure the highest priority requests were accommodated.

Phase 2 – Maximize Efficiencies

Workload balancing was introduced to spread backup jobs start times within the available windows. Network paths were upgraded and jobs redeployed to avoid bandwidth bottlenecks.

Phase 3 – Policy Assessment Initiative

This phase was considered the most important facet of the entire solution. MDIT staff brought customers, DBA's, systems administrators, telecommunications, security, help desk and data center staff together to determine statewide policies and procedures for the enterprise storage and backup solutions. Topics of the facilitated session included:

- Design standard policies by categories – databases, file systems, e-mail
- Standardization of Backup Configuration Policies
- Develop ILM and Backup categories based on RTO and RPO
- Establish reporting needs and communication plans

This workshop selected a Backup Action Team from the participants and provided a governance model for future decisions.

Time in Operations: The storage solution has been active and effective since 2001. Although in operation just as long, the new enterprise backup improvements have been completed since February 2008. These improvements have consistently raised backup success rates to over 90% and recovery rates to 100%.

Leverage and Transferability: See Section E

Communications: Throughout the challenges placed on our staff and infrastructure, clear communication was of paramount importance. MDIT is committed to integrity and full transparency even when service levels are not what they need to be. In the end we believe this approach builds trust and develops strong collaboration.

Section D: Significance

State Agencies:

Improved Service Levels **–** Backup and restore success rates improved from a low of 65-70% to the current average of 96-99%.

Recovery and Consistency of Critical systems **–** The solutions provide fast, timely availability of the business data in the most cost effective manner for Michigan's mission

critical applications. Those served by these solutions include: state law enforcement systems, disease surveillance, food inspections systems, veterans hospitals, air quality control monitoring, revenue and tax systems, economic development and licensing systems, state asset management systems, correctional facilities control and offender tracking to name a few.

Better communication and reporting **–** Each agency now receives ongoing reports of backup failures and successes. Errors are automatically referred to server teams and proactive troubleshooting is done before the client knows that a problem had occurred.

Policy Alignment **–** The strategic direction toward enterprise disk storage and backup capability is aligned to both the Cabinet Action Plan and the 3rd goal from the MDIT Strategic Plan to "Improve IT Service Management and Infrastructure." In addition to this goal the effort has created positive direction for a multitude of strategic goals. Storage solutions have been a component of broader efforts to improve everything from "greening" the state's technology to cutting operational costs (both through volume discounts and consolidation).

Citizens:

Peace of Mind **–** The State of Michigan citizens know that their data is protected and secure and ensures that they will have the services they use on a daily basis available wherever and whenever they need it.

Lower Costs **–** Each and every year the charges for ensuring the state's critical application and data have dropped and allowed agencies to allocate those funds toward citizen programs.

MDIT:

Ease of Support **–** Standardization and common processes has reduced complexity and allowed staff to focus solely on systems administration duties and get involved only when there is a true issue.

Increased staff capability **–** Due to use of best practice standards, processes, and a shared technical knowledge, teams have the ability to support additional demands and deliver quality service within expected timelines. The stage is also set now to accommodate the storage, backup and recovery needed for the newer demands caused by e-Discovery, and the natural growth of application data.

React to Client Demands **–** The enterprise storage and backup solution give MDIT staff the ability to forecast utilization and meet client demand within hours of a request.

Section E: Benefit of the Project

Qualitative Improvements:

- ***Clear Priorities in a Disaster*** **–** Categorization of server environments based on criticality (RPO/RTO requirements) means that Enterprise Storage and Backup and Recovery clearly understands the functions and can allocate resources on a priority basis to server environments during a disaster.

- ***Improved Communication with Users*** **–** As disaster recovery becomes a paramount concern, the collaborative approach taken by MDIT ensures that agencies determine the business criticality of their systems, which fosters an open dialogue throughout the state and creates transparency in reporting.
- ***Transferability*** **–** Common processes that are documented and repeatable mean that any state could benefit from lessons learned. When polled by Business Technographics® 61% of government decision makers listed disaster recovery as one of their top budget investments for 2007. We are approached every month by states undertaking similar efforts of varying sizes. Whether your disaster recovery effort covers 50 servers or 5,000, there is much to be taken from Michigan's model. We are most often asked to share our rate structures (that are used consistently with federal projects), the architecture and configuration of our SAN fabric, and, most recently, the approach for partnering on critical functions like backup and recovery.

Measurable Operational Improvements:

- Raised Backup success rates from 65-70% to current average of 96-99%.
- Reduced initial backup installation time frames from 15 days down to 3 days.
- Upgrades in storage cut batch processing by 4-5 times. Michigan's payroll took five full days to process and that meant that no HR data could be accessed during that time frame. After storage upgrades, this processing is accomplished in just three days. Child Support and Department of Corrections' offender management systems went from 18 hour batch windows down to 4 hours without changing one line of code. This wider processing window meant that backup windows were larger and contributed to improved success rates.

Financial Savings / Cost Avoidance:

The table below shows the dramatic price difference Michigan has attained with its enterprise storage offering. A combination of volume, staffing efficiencies and contracted price reductions has resulted in one of the most competitive storage and backup/recovery solutions available with rates dropping every year.

Storage Service	2001 Rates	2006 Rates	2008 Rates	2008 Volume
High-End	$27.50-55/GB*	$8-16/GB*	$8-16/GB*	689 TB
Mid-Tier	N/A	$6.00/GB	$4.00/GB	611 TB
Low-End	N/A	$2.00/GB	$2.00/GB	1.1 PB

*High range includes Remote synchronous replication, business continuance volumes, and backup & recovery. Rates include the total cost of supporting an enterprise function, including staffing, license, equipment and maintenance costs.

Michigan's Enterprise Storage Backup and Recovery project has changed the entire business continuity and disaster recovery capability in our state. MDIT's remote synchronous capability is matched only by some of the world's largest companies and financial institutions. ILM has allowed our teams to ensure a consistent, recoverable and repeatable solution in any disaster situation.