DTS

UTAH DEPARTMENT OF TECHNOLOGY SERVICES
August 2010

Data Center Consolidation Initiative

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Overview: Data Center Consolidation Initiative

The State of Utah Department of Technology Services (DTS) has implemented a Data Center and Server Consolidation. The initiative included the consolidation of data centers and servers throughout the Executive Branch agencies in the State. The project was successfully completed in a short 12 months, with a 6 month planning period beforehand. The results of the project include:

- Reduced the number of data centers in the State from 35 to 2

- Reduced the total number of physical servers from 1864 to 591

- Save the State $4 million annually ongoing in server, support, and energy costs

- Increased security

- Increased performance

Performance throughout State applications has improved significantly with the completion of the consolidation. The consolidation has allowed resources to be broken into smaller, more flexibly used components and pooled for more effective utilization. Below are a few of the many instances where consolidation and virtualization has increased performance, allowing the State to become more efficient, improve business practices, and provide better service to citizens:

- 60% performance gain on a Data Warehouse batch job that is regularly run at the Department of Workforce Services

- Perceivable 30% performance increase at the Department of Health when accessing data files with outside entities

- Total runtime for State Payroll decreased from 39 hours to just 3.5 hours, and realized a cost avoidance of $300,000 in hardware
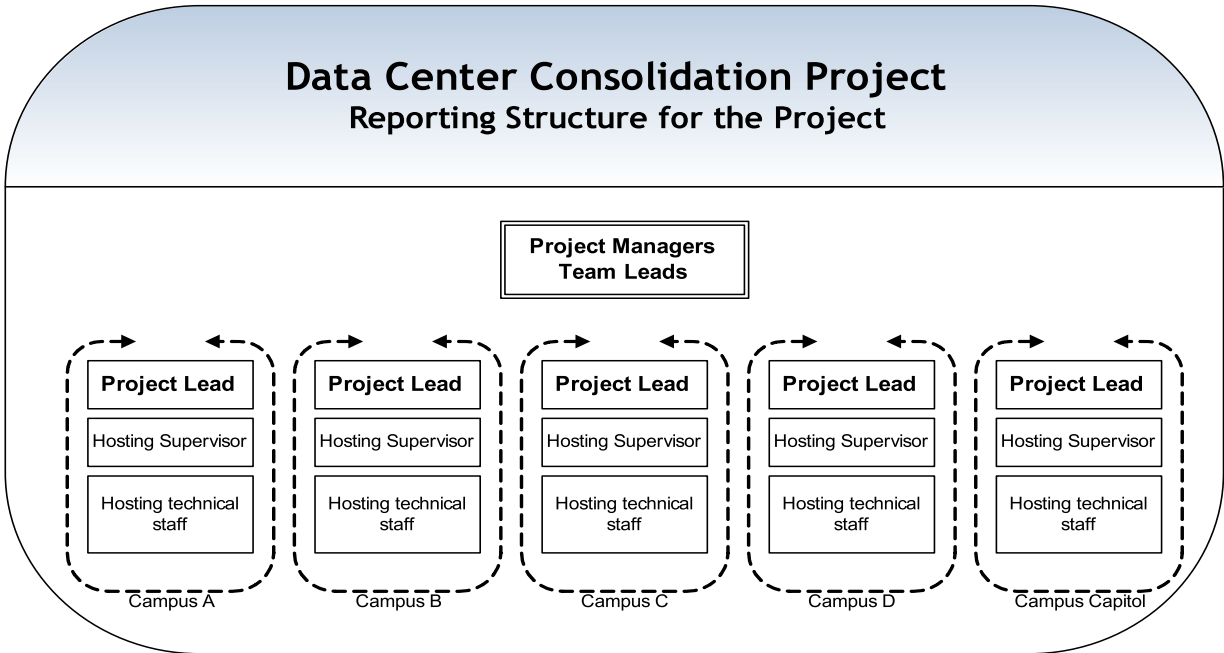
Project Summary

The Data Center Consolidation project for the State of Utah commenced on January 6th, 2009. Three Project managers were chosen to oversee the project, each with differing IT backgrounds and experiences. In the initial kickoff meeting, the following four objectives were presented and discussed:

- Reduce the data center count within the Utah Executive Branch from 35 to 2

- Reduce the number of servers in the 35 data centers from 1700 to 400

- Achieve an ongoing yearly savings of 4 million dollars.

- Complete the project by June 30, 2010

Planning involved meeting with vendors and states who either had conducted their own data center consolidation initiatives internal to their company or state, or had consulting expertise in successfully planning and implementing a data center consolidation project of our size and scope, or who sold hardware/software that could be used in such a consolidation effort. Specifically, IBM, HP and Sun Microsystems were a few of the many companies who worked with DTS, offering either free consulting or consulting at extremely reduced rates to help in the planning process. Both the states of California and Oregon also offered valuable feedback on previous and current consolidation efforts.

To help manage the project, it was decided to manage at the level closest to the customer. All of the 35 data centers existed in one of seven campuses, with hosting personnel assigned to work in each of those campuses. A project lead was identified in each of those seven campuses with specific instructions to develop a plan to virtualize and move systems in their campus, to one of the two enterprise data centers located in Salt Lake City or Richfield.

Data Center Consolidation Project
Reporting Structure for the Project

Project Managers Team Leads

Project Lead	Project Lead	Project Lead	Project Lead	Project Lead
Hosting Supervisor	Hosting Supervisor	Hosting Supervisor	Hosting Supervisor	Hosting Supervisor
Hosting technical staff	Hosting technical staff	Hosting technical staff	Hosting technical staff	Hosting technical staff
Campus A	Campus B	Campus C	Campus D	Campus Capitol

By having a project lead at each campus, the project was managed at the level closest to the business and gave the seven project leads the ability to focus on issues unique to the customers in their respective campuses. It also allowed the Project Managers overseeing the entire project to manage the project more like a program made up of multiple projects, rather than one large project. ***This allowed the campuses to make progress independent of the other campuses and allowed the campuses to work concurrently rather than consecutively, which dramatically reduced the amount of time needed to complete the project***.

Along with having project teams at each campus focused on doing consolidation and virtualization of servers and server migration, project teams were established surrounding enterprise operational needs of hosting, networking, storage and backups, and virtualization. Each of these teams had one representative from each campus on the team so that the campus would have their operational concerns addressed as the technical architecture was planned for and implemented.

March 2009 through December 2009, decisions were made on hardware, software, and consulting services. The following was decided:

Hosting: A decision was made to standardize the virtual platform on HP hardware using HP Blade Centers (c7000) and blades (BL460c G6). Each chassis was populated with 16 blades. Each blade was populated with 96 GB of RAM.

Virtualization: The decision was made to virtualize using VMware. Because the decision was made while VMware was in the midst of updating its product line from 3.x to VSphere 4.0, and because of concerns with deploying a dot 0 product, DTS elected to stay with the 3.x product for this project, with the intent of migrating to 4.x after the project was complete.

Backups: DTS already had a significant deployment of IBM's Tivoli Storage Manager in their previous environment, along with experience in using that product. Because of this, the team decided to continue using the Tivoli product. Continuing to use Tivoli Storage Manager, which was already a sunk cost, saved the expense of purchasing a replacement backup solution and lessened the time needed to deploy a similar competitor's solution. To help lower costs of storing backed up data, DTS deployed a de-duplication storage product from Data Domain (dual DD880 controllers, 140 TB of storage in each controller, one controller deployed in SLC and Richfield Data Centers). The Data Domain solution was implemented as virtual tape drives and wrote the data directly to disk, speeding up both the backup and the restore processes. As an archival option, DTS can choose to move backups to tape based on the number of days residing on disk.

| Storage:	The team decided to deploy a Sun 9990v (rebranded Hitachi USP-VM) in each of the data centers with modular storage (Sun Storage 6780s and Hitachi AMS 2500) behind each of the controllers. This allowed the team to virtualize the storage and save space and money. Now, instead of having allocated storage taken out of the allocation pool when it is initially requested by the system administrator, storage space is marked for use but is not completely committed to the system until the system actually uses the storage. This allows for storage architects to intentionally over subscribe storage space. By tracking actual use of the storage, the storage architect can still plan for expansion without being forced to expand because storage was requested but not used. The SAN fabric is dual Cisco MDS 9513 with 4/8 GB capability. The management of the system is conducted using Tuning Manager and Tiered Storage Manager. Tiered Storage Manager gives us the ability to migrate data from different tiers without any disruption to the end user.
Networking:	The hosting area was expanded to handle the influx of servers to the Salt Lake Data center. Two new hosting rows were built, each with a Cisco Nexus 5010 24 port 10 Gig switch. Each of the HP Blade Chassis was dual homed to each of these switches. ACE modules that already existed in the core network infrastructure were provided to systems that required the network, so that failover could occur for systems that needed redundancy. Firewall Service Modules were also scaled so that each agency could maintain their own firewall instance, thereby allowing the agency to continue being the custodian of their own data without having to negotiate with other agencies over access privileges or security requirements of the data. Additionally, a second redundant data path from the state WAN was installed in the Salt Lake Data Center (SLDC). The second line was given a separate physical path than the first line. Finally, a second Internet connection from a different service provider was installed to offer further redundancy to the SLDC with all internet traffic being load balanced across both internet connections.

As DTS worked through the planning process with each of the campuses, which included verifying the number of servers and data centers, it was discovered that there were actually 1864 servers and not 1700, an increase of 9% over the initial server count. Fortunately, the increased server count was discovered early enough that DTS was able to scale the architecture to account for the increase.

The actual work of physically migrating systems from the 35 data centers to the Salt Lake and Richfield Data Centers started taking place in earnest in January 2010. Over the life of the project, the following is what was reported by each campus:

Utah Data Center Consolidation Project Jan 2009 – June 2010								
	Camp us A	Camp us B	Camp us C	Camp us D	Camp us Capit ol	Camp us CR	Camp us Rural	All Total
Total Servers (Original)	316	239	248	233	736	54	38	1864
Data Center Completed	4 of 4	8 of 8	5 of 5	5 of 5	5 of 5	2 of 2	6 of 6	35 of 35
Servers Completed	316	239	248	233	736	54	38	1864
Physical Servers (Final count)	71	72	78	43	224	25	9	591

Below is a breakout of the Data Center Consolidation Project by week. The numbers on the left reflect the number of servers that were dealt with in the project. The numbers on the bottom reflect the weeks in the project. Week one occurred the first week of November 2009. Week 37 occurred the last week in June 2010. The straight blue line is the trend line that needed to be met if the project was to be finished on time. The straight red line is the trend line of the actual consolidation work done for the project. The thick red line represents the actual work done for each week of the project.


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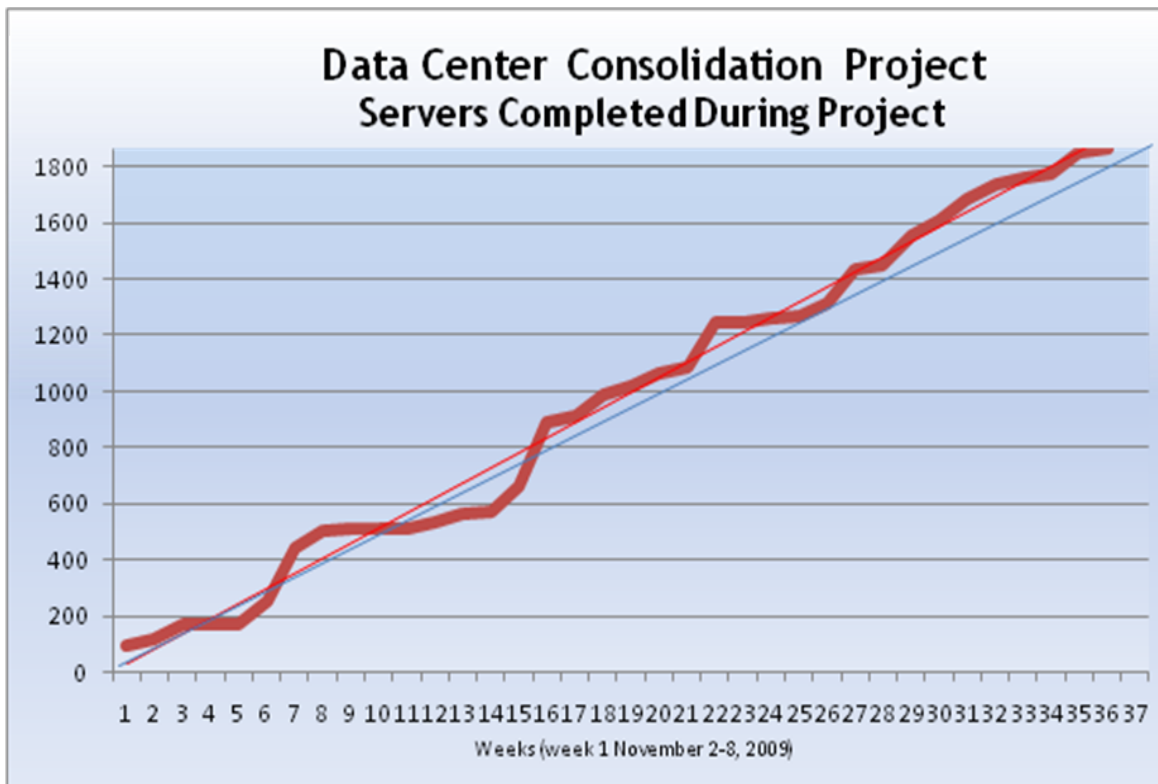
Accomplishments

The Data Center Consolidation Project was able to realize the following overall accomplishments:

1. Successfully consolidated 35 existing data centers down to 2 data centers.

2. Successfully reduced physical server counts from 1864 servers, to 591 physical servers, a 68% reduction in server counts. In two different consulting engagements, the State of Utah was told that as an industry average, 20-30% of the servers in a consolidation effort are typically not able to be virtualized and moved, virtualized only, or moved only. The project came close to meeting the industry average even though a decision was made to not move database servers into a shared virtual environment because of concerns over costs of licensing databases in that environment.

3. Built out a scalable enterprise storage environment that allows for Tier 1, Tier 2, and Tier 3 data storage.   The storage is flexible enough to allow for modular storage from multiple vendors, yet robust enough to handle even the most demanding applications.

4. Successfully trained the majority of system administrators within Utah Department of Technology Services (20-25 employees) to effectively use the Hosting Environment's virtualization hardware and software.   These employees had very little knowledge of this technology or used it minimally before the project began.

5. The network team for the state successfully configured and implemented MPLS on the state's core network. To ensure that communication to systems relocated from the agency sites would not be inhibited by non-critical internet traffic, QOS was configured at many of the agency sites that used to have the servers housed locally.

At a Campus level, the Data Center Consolidation Project was able to realize the following accomplishments:

Campus A (DWS, Commerce, Labor Commission, DWS e-REP American Fork)

Measure	DWS - Main	Com- merce	Labor Commis sion	DWS - eREP Americn Fork
Delivery Target	6/22/10	11/20/09	10/24/09	9/21/09
Total Servers Completed	276	10	10	20
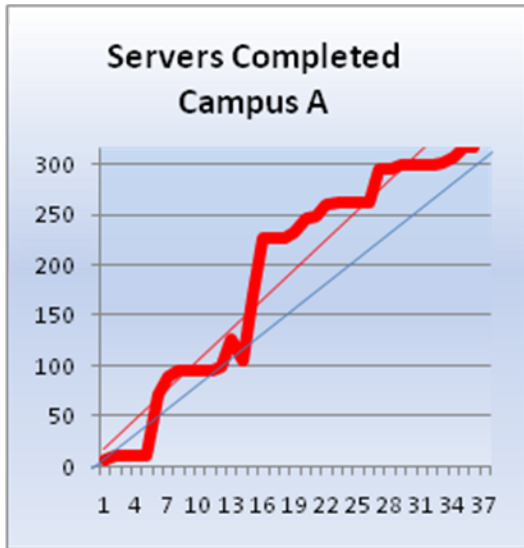
In preparation for the server moves, the hosting staff assigned to Campus A successfully segmented a network at the main Department of Workforce Services building consisting of 300+ servers into four different networks without impacting the agency. While this was a necessary configuration change to ensure a successful migration of DWS servers, the reconfiguration had the added benefit of alleviating some recurring random network problems on the local area network.

With the help of Network Operations, the technical staff successfully implemented MPLS and Psuedowire so that a DWS 50 server migration for DWS could be completed over a over a four week time period instead of one night. By implementing Psuedowire, the subnet for DWS CUBS, CATS, and E-work existed at both DWS and the SLDC so that as servers moved, they continued communicating with servers as if they were all located at the same physical location. This allowed for a more methodical move of these mission critical systems and met the requirements of the business.

When DWS started out with the Data Center Consolidation project, there were 278 servers. After many of those server instances were migrated to the shared hosted environment being used by all of the other agencies, DWS was left with 71 physical servers. 30 of the Sun Microsystems systems were consolidated down to 15 Sun Boxes or Linux instances in the shared environment, a significantly less costly alternative to Sun. In some instances, there were significant performance gains in the migration. One system administrator reported a 60% performance gain on a Data Warehouse batch job that is regularly run.

Much of the DWS data center migration occurred during quarter end for Unemployment. Even though it was a record-breaking quarter for the submittal of new and recurring claims for the state, the migration was able to occur with very little impact to the agency.

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Campus B (DHS, Tax, DEQ, DCC)

| Measure	State Library	324 S. State	DEQ	DHS Admin	ORS	Tax	USDC	USH
Delivery Target	2/6/10	11/30/09	4/30/10	11/30/09	2/28/10	6/30/10	5/30/10	6/30/10
Total Servers Completed	6	1	37	64	14	99	7	11

Servers Completed
Campus B
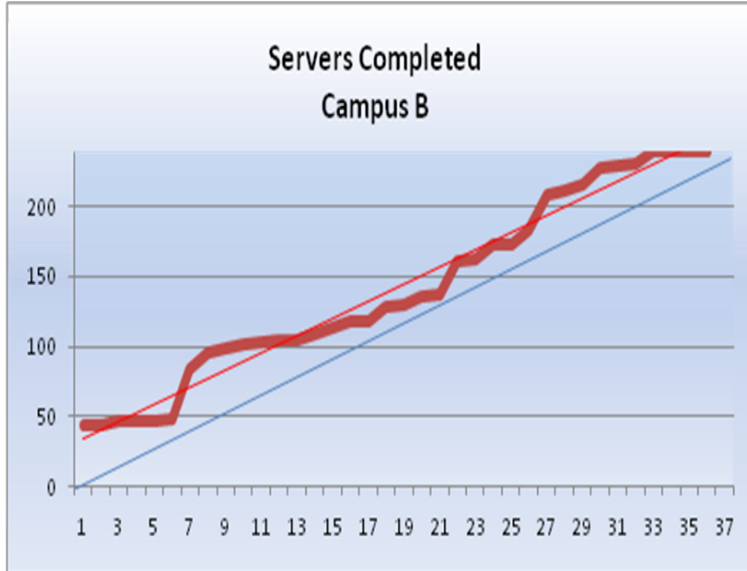
The major applications for the Campus B data centers were successfully moved to the SLDC with little or no downtime experienced by the majority of customers. Some of the notable systems moved include:

- SAFE (DHS)
- Motor Vehicles (Tax)
- Gentax (Tax)
- Documentum (DEQ)
- KLAS
- Webgrants
- eChart

Approximately 167 servers from Campus B were eliminated by moving system to the shared environment and consolidating applications onto the same servers.

Campus C (UDOT, UDOT TOC, UDOT Region 2, DPS Rampton, DPS POST)

| Measure	UDOT Calvin Rampton Center	UDOT TOC	UDOT Region 2	DPS Calvin Rampton Center	DPS Post
Delivery Target	3/31/10	5/15/10	5/15/10	5/15/10	5/15/10
Total Servers Completed	153	47	8	36	4

Servers Completed Campus C
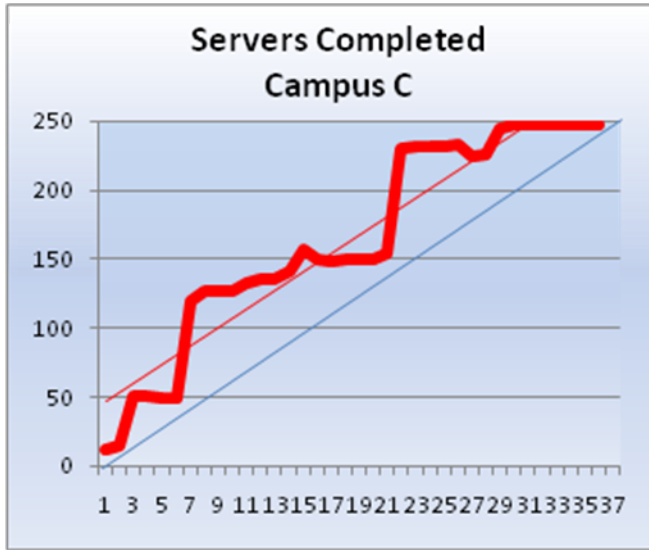
Campus C successfully planned and coordinated a migration of 62 Virtual servers and 12 physical servers to the Salt Lake Data Center on the same day. Falconstor replication technology was used to facilitate the migration of virtual machines and data to the Salt Lake Data Center prior to the cut over weekend. Planning meetings included Campus Infrastructure staff, Application Development staff and key business customers. Each of these separate groups had the responsibility to perform testing to ensure that the applications worked as expected before and after they were moved. The move started on Saturday March 20th, at 6 AM and by 9:30 PM, the application development group had certified the Application Developers as well as the business customers. Because of the excellent planning and implementation of the Campus, the migration was virtually transparent to the customer.

Campus D (Health, DNR, ABC, DOH 44 Med, Agriculture)

| Measure	DOH and CHB	DABC	DNR	DOH and 44MED	Agriculture
Delivery Target	5/30/10	5/23/10	5/30/10	5/30/10	12/31/09
Total Servers Completed	143	7	68	9	6
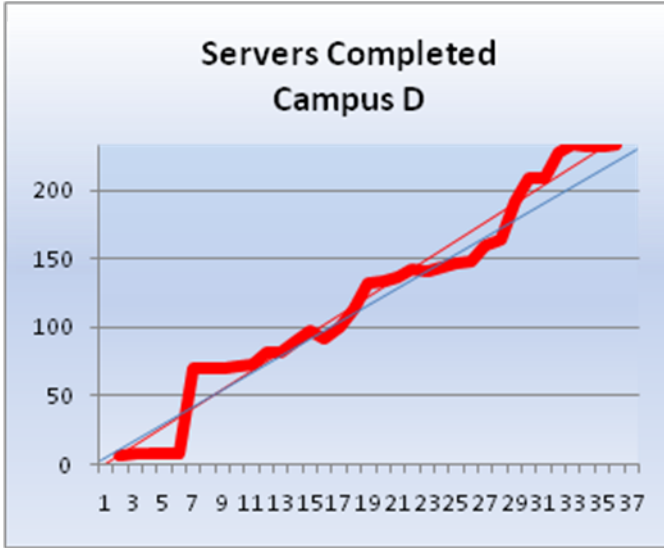
Campus D began the project with a target of over 250 servers spread across 4 Datacenters. 96 servers were retired or their services were consolidated to other servers, 130 servers were virtualized then moved to the SLDC, 21 servers that could not be virtualized were physically moved to the SLDC and 20 new servers were created at the SLDC which resulted in a significant hardware savings for the Agency Programs.

Campus D successfully moved three "N-Tiered" systems that supply remote applications to users throughout the state via P2P-VPN connections with outside entities for bi-directional message exchange. These services were successfully re-created at the Salt Lake Data Center, and provided a nearly seamless transition from the VPN concentrator at the Canon Health Building. Reports received from the users affected by these moves indicated a perceivable 20-30% performance increase accessing data files, and an overall application performance improvement.

Campus Rural (Ogden Regional Center, Provo Regional Center, Clearfield West, UDOT Regions 1,3,4)

| Measure	Ogden Regional Center	Provo Regional Center	Clearfield West	UDOT Region 1	UDOT Region 3	UDOT Region 4
Delivery Target	5/30/10	2/28/10	11/30/09	5/1/10	5/1/10	5/1/10
Total Servers Completed	8	6	4	6	6	8
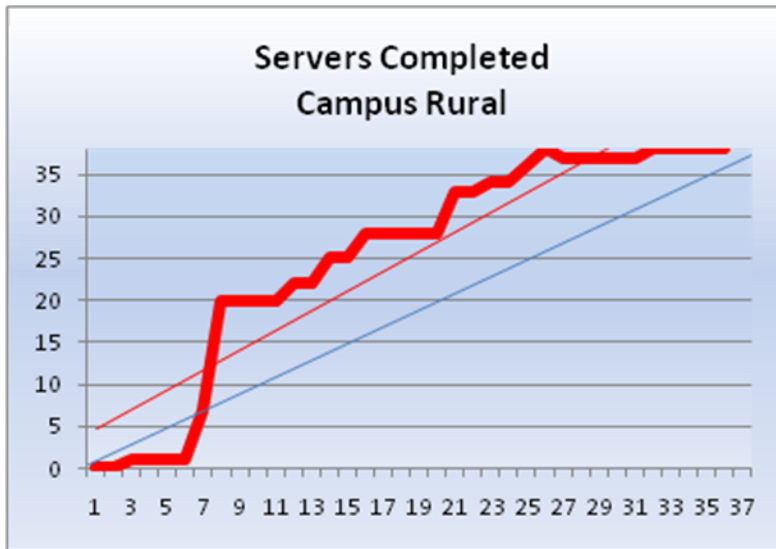
The rural campus discovered 8 servers in the rural campus that were being used as internet filters. By enabling reporting for the enterprise internet filtering already in place, the customers agreed to turn off the internet filter they were paying for. This will result in a cost savings for the state as redundant services like this that are no longer needed are eliminated.

UDOT region offices in Orem and Ogden had six servers and five servers respectively. When consolidation and virtualization was completed, each location had one server running one virtual host with four or five server instances (Windows and Novell), and one backup server.

## Campus Capitol (all servers in SLDC and on Capitol Hill)

Measure	Salt Lake Data Center	Governor's Office	DHRM	Division of Finance	Richfield Data Center
Delivery Target	6/30/10	6/30/10	8/30/09	4/30/10	6/30/10
Total Servers Completed	609	17	23	14	73
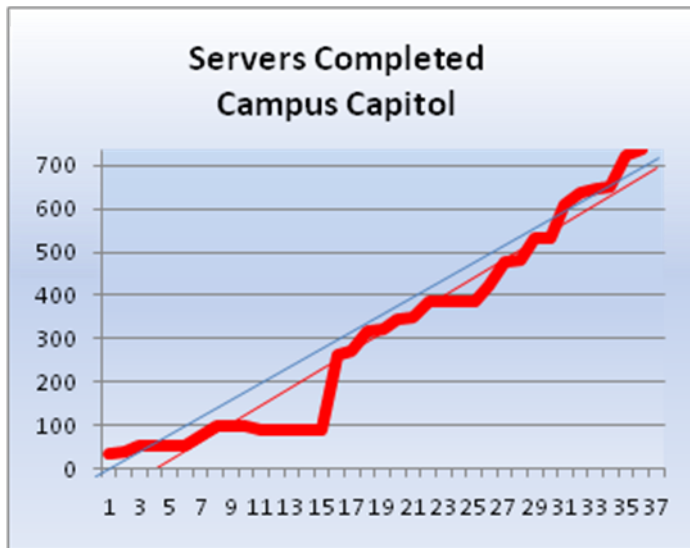
Working with the Division of Finance, SAP was migrated from an HP-UX hardware platform to a SuSE Linux VM environment. This saved the Division of Finance from purchasing new PA-RISC or Itanium HP hardware and has shown improvement in the performance of batch processes as well as the Employee Self-Service (ESS) portal for time-entry. Total runtimes decreased from over 39 hours to just 3.5 hours.

Campus Corrections (Point of the Mountain, Gunnison)

Measure	Draper Data Center	Gunnison
Delivery Target	3/31/10	3/31/10
Total Servers Completed	50	4
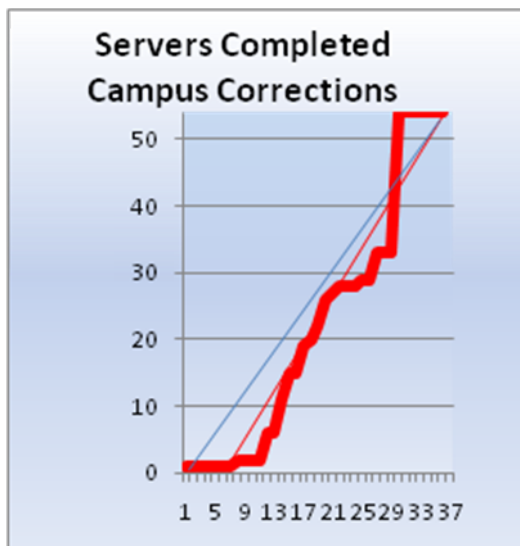
The Corrections technical staff had moved to a virtual computing environment on HP blade servers a few years ago meaning they were already versed in the technology required for the consolidation effort. Nearly half of the 53 servers were already in a virtual environment giving the staff an advantage in the task of moving the servers to the SLDC virtual infrastructure. The biggest challenge was in coordinating individual server moves with Correction business units, units that many times had 24/7 uptime requirements. Coordination of server moves was, by far, more challenging than the technical aspect of the migrations.

Actual expenses – final budget

DATA CENTER CONSOLIDATION PROJECT							
DTS One-Time Costs							
Data Center Project Purchases	Anticipated Cost	Budget $ Remaining	Budget $ Spent	DC	Purchases		Actual Cost
(DC1)Hosting (X86)							
	Proposed purchases				1.1	HP/IBM Blade Systems	$1,697,664
DC1.1	7 Blade Centers @ $230,000 (112 Blades)	$1,091,063			1.2	3 DL380 Metro assist	$62,248
DC1.1a	Additional Blade Centers	$465,040			1.4	SAS drives	$3,536
DC1.2	3 DL 380 servers to assist Agency's in Virtualization	$37,276			1.5	RAM	$20,315
DC1.3	3 DL 380 servers to assist Rural's Virtualization	$32,000			1.6	Acronis	$1,614
DC1.4	Extra SAS hard drives to aid in virtualization at	$6,000			1.3	3 Rural Virtualization Servers	$33,032
DC1.5	RAM for Data Warehouse server (DWS)	$15,645					
DC1.6	Disk Imaging software Acronis (Capital)	$1,614					
DC1.1b	Additional Blade Centers	$132,500					
	Total	$1,781,138	-$208,409	$1,818,409			
(DC2)Monitoring							
	Total budget				2.1	Tuning Manager	$13,044
DC2.1	Tuning Manager software for SAN Storage	$13,943				up.Time CP Software	$101,523
DC2.2	Capacity Planning and Monitoring Software	$100,000					
DC2.3							
	Total	$113,943	$45,433	$114,567			
(DC3)(Sun,AIX, etc) /Agency Hardware							
	Total budget				3.3	Equipment trade in compensation to Agencies	
DC3.1	SUN	$300,000			3.3	HP trade-in credit	-$19,018
DC3.2	AIX	$230,000			IN4.6	Phase III Storage (Excess budget spent from this category to aquire additional storage)	$1,095,029
DC3.3	Agency Hardware buy back	$300,000					
	Total	$830,000	-$246,011	$1,076,011			
(DC6)Virtualization (Vmware)							
	Total budget				6.1	3 year contract for Vmware	$897,491
DC6.1	VMWare Enterprise License	$900,000			6.2	VmWare Heartbeat	$14,926
DC6.2	VMWare vCenter Server Heartbeat	$11,081					
	Total	$911,081	-$12,417	$912,417			
(DC7)Developer/Consultant Costs							
	Total budget				7.1	Finance SAP	$14,000
DC7.1	SAP Finance	$14,000			7.2	TSM Consultant (TEK Systems)	$139,400
DC7.2	Sys Admin to augment Agency Staff (Tek	$340,900			7.2	VM Consultant (Compunet)	$173,700
DC7.3	Agency Development Cost	$275,000			7.3	Vendor Hardware moves assist.	$22,106
DC7.5	Vendor Hardware moves assist.	$4,089			7.6	Core Team Travel	$3,190
DC7.6	Core Team Travel	$3,190					
DC7.2	Consultant Costs	$38,200					
DC7.3	AMS 500 Maintenance (TAX)	$10,800					
	Total	$686,179	$147,604	$352,396			
	Total	$4,322,341	-$273,800	$4,273,800			

Successful Practices and Lessons Learned

- Ensure the project plan has clearly defined objectives and deliverables to prevent scope creep

- Break up the project into manageable parts and run the project as concurrent multiple projects instead of one consecutive project

- Give each project group the responsibility to form their own plan and accountability for achieving the architected plan

- Create a CMDB of all equipment impacted by the project the first step in the project

- Regular communication is essential for a successful project

- Regular and consistent communication needs to exist between enterprise groups (e.g hosting, storage, networking) and IT staff assigned to the campus

- Ensure teams are being heard

- Give visibility to the progress of the project

- Customer Communication - Maintain a high level of communication with the customer and the Campus IT manager about the project

- Ensure there are single points of contact for each of the functional areas of networking, storage, virtual environment, and data center

- Don't rely on email as the sole source for communicating changes and requests for the project

- Ensure funding levels are appropriately identified for the project

- Ensure technical groups are committed to the project

- Ensure the organizational structure is aligned with project

- Executive support is essential to the success of the project

- Identify processes of moving the hardware and communicate those moves to the enterprise groups

- Understand that even with good sound processes and adequate planning, tasks are going to be forgotten in a large-scale move, and technical teams will need to possess the agility to react to the situation

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- Incident, problem, change and reliability management tools and processes should be in place prior to project initialization to prevent service level issues

- Not every campus can or should do their moves like the other campuses
- Ensure the enterprise group has the hardware and people in place to handle the scaling of systems and resources that will need to occur

- Virtualization is not a one solution fits all

- With complex systems, it was easier to P2V than to migrate them. With simplistic systems, it was easier to migrate than to P2V.

- Set time frames for task completions to allow for application testing before/after server migrations

- Ensure that staff have knowledge of a virtual server environment

- Judicious use of consultants to fill in the knowledge gaps

DTS
DEPARTMENT OF TECHNOLOGY SERVICES

Data Center Consolidation

Issue 1   **November, 2009**

Data Center Consolidation

Planning for the Data Center Consolidation project began in January 2009. The primary goals of the project include consolidating the 27 existing data centers down to two, and reducing the physical server count from around 1700 to 400 or less. In accomplishing those goals a four-million dollars per year savings is expected to be realized by the state starting FY2011. A completion date for this project is scheduled for June 30, 2010.

The Project Core team was formed in early January 2009, and consists of Tim Cornia, Nick Alleman, and Greg Jackson. They've been tasked with developing and executing an overall project plan. A integral part of this plan will be building an enterprise infrastructure capable of supporting the IT Hosting needs of the Executive branch agencies.

The first six month of the 18 month project were spent studying consolidation methodologies, securing and upgrading current infrastructure to enterprise levels, and ensuring that each of the individual Campuses have viable project plans in place to meet their completion dates.

Major upgrades have been made in both the Hosting and Storage environments. HP and IBM enterprise "Nehalem" Blade Centers configured with 92 GB of RAM are being used in the hosting environment and a 300 TB SUN / Hitachi SAN with Fiber/SATA drives in the storage environment.

Other significant upgrades in SAN Networking include the purchase of two Cisco 9513's. These switches are configured with 8GB ports. This is a significant upgrade from the previous SAN network which supported only 2GB. Additionally we've increased the port count from 2 connections to 8 connections from the fabric to the storage. The anticipated throughput to the new SAN should be very noticeable improvement to our Agency customers.
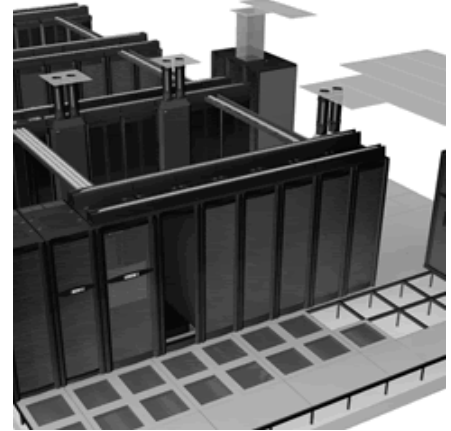
Project Status

Virtualized/Moved	**98**
Virtualized/Not Moved	**134**
Not Virtualized/Moved	**5**
Not Virtualized/Not mov	**40**
Virtualized only	**26**
Data Centers Closed	**5**
Servers Decommissioned	**22**

Campus Leads

The overall project was divided into six separate projects based on the DTS Campus model. In each of the Campuses a Project lead was chosen. The Project leads for each of the Campuses are as follows:

Campus A   - Richard Langford

Campus B   - Peter Freeman

Campus C   - Joe Tripp

Campus D   - Terry Forsgren

Capitol   - Darrus McBride

Rural Central   - Jonathan Foster

Rural   - Stuart Roundy

The Campus Project Leads working hand in hand with the Campus Hosting Supervisors will be responsible for the Server consolidation and the eventual move to the Salt Lake Data Center.

The CORE team holds weekly meetings with the Campus Project leads and Hosting Supervisors to discuss current status of both the consolidation and enterprise infrastructure upgrades.

Data Center Consolidation Project Objectives

- Consolidate from 27 Data Centers to 2 Data Centers

- Save $4 million in ongoing costs

- Reduce server counts from 1700 to <400

- Create a True Enterprise Infrastructure environment

Sub Team Concept

It was decided when the project was first organized to stand up Sub Teams and appoint Leads in each of the following areas:

- Networking - Tim Cornia / LaRon Taggart
- Hosting - Darrus McBride
- Virtualization - Jonathan Foster
- Data Center - Dan Gallegos
- Storage / Backup - Roger Bishop / Nick Alleman

Additionally each of the sub teams consist of subject matter experts chosen from each of the campuses.

These sub teams were tasked with looking at the state of their assigned environment and make recommendations for improvement. These recommendations might include: Equipment upgrades, creating new or updating current policies and procedures, and architecting and implementing new technologies.

The Sub Team Leads meet bi-monthly to coordinate their individual team plans with the other Sub Team plans to ensure compatibility and avoid potentially costly changes.

Network Sub Team

"The group has identified 25 major tasks that need to be addressed for the consolidation."

The Network sub team has been in place for six months. The members of the team are:

- Tim Cornia—co lead
- LaRon Taggart—co lead
- Bobette Phillips—security
- Brant Davis—campus perspective
- Charmaine Malan—network operations
- John Stucki—strategic planning
- John Stevens—campus perspective

The group has identified 25 major tasks that need to be addressed for the consolidation. Those tasks have been assigned out to the team members and they have been asked to identify the steps that need to be taken to complete those tasks. That information will be used to produce a Gantt chart and help us track the tasks as they are completed by employees within DTS or consultants .

Network benchmarking continues to be the biggest concern and networking people in the campuses are being asked to gather network utilization data to better understand the applications and how they will perform on the WAN.

Virtualization Sub Team

"The Virtualization team decided to standardize on VMware 3.5 due to the maturity and stability of the version."

The Virtualization Sub Team has been tasked with creating an enterprise VM environment and support structure. The team has been working on maturing the process and procedures for the VM environment including ESX server automatic building, storage procedures, and process checklists

DTS currently owns an enterprise VMWare License, allowing DTS unlimited use of VMware for a period of three years. While DTS could have deployed VMware 4.0 (vSphere), the virtualization team decided to standardize on VMware 3.5 due to the maturity and stability of the version. The Team is currently formulating a plan to move to vSphere 4.x in July 2010.

Virtualization Sub Team Members include:

- Team Lead/Rural: Jonathan Foster
- Capitol Campus: Patrick Funk
- Campus A: Jeff Bartholomew
- Campus B: Ken Ainge
- Campus C: Shawn Lowry
- Campus D: Benjamin Goodrich

Because campus support is one of the most import aspects of the Virtualization Sub Team, a representative from each campus has been included on the team to ensure a campus perspective is considered before making any decisions.

If you have any questions please contact your campus virtualization representative.

Data Center Consolidation

The Salt Lake Data Center

Data Center Consolidation

Two VM consultants have been brought in to help with the virtualization process at Campus D and the SLDC. DTS staff at Campus D had high praise for their consultant saying they were a "valuable resource" in the process.

A data deduplication and VTL solution will be purchased and in production shortly, allowing for many of the backups to reside on disk instead of tape. (more information about this in the following article)

Software and or consulting services are being considered to assist in the transfer of VMs that already exist at the campus.

Such software would allow for VMs to be replicated from the campus to the SLDC without severely impacting WAN traffic, as the software allows for the sys admin to determine how much bandwidth they wish to consume. When the system administrator is ready to convert to the migrated system, he takes the local VM instance offline and brings the migrated VM online, thus shortening the downtime of the migration. This software will offer one more option to the system administrators as they prepare to migrate systems.

Project Status

Virtualized but waiting to move	**225**
Servers completed	**510**
Data Centers Completed	**9**
Completed % of work	**27**
Physical Servers (Final Count)	**TBD**

TSM (Tivoli Storage Management)

IBM Tivoli Software is a suite of system management products. DTS makes use of IBM Tivoli Storage Manager or TSM, within this software suite. TSM is used to provide backup/archive, restore/retrieve, and a level of disaster recovery protection for data that resides under the DTS umbrella.

The consolidation project has identified the need for upgrades in numerous areas. One of these is our current TSM environment. We have two TSM backup servers, one in our Salt Lake data center and one in Richfield. Most of the clients (servers backing up to TSM) exist in Salt Lake. However, half of the Salt Lake clients are being backed up to Richfield. The Richfield TSM server then creates additional copies coming back to Salt Lake.

It is our intent to stand up a new environment to accommodate new clients from the consolidation effort, and gradually migrate present TSM clients from the existing environment to the new TSM environment. Our new implementation will consist of clients backing up to multiple TSM servers in Salt Lake, and one in Richfield. These TSM servers will stream data to a DD880 Data Domain disk storage appliance in each of the respective locations. This appliance is capable of deduplicating data and emulating a tape library. There are many advantages to deduplication, three of them are particularly noteworthy. 1. Data is both backed up and restored locally. 2. Both backups and restores will occur much faster then with the current system 3. All backups will be duplicated off-site (Salt Lake to Richfield or the inverse) with only deduplicated data traversing the Wide Area Network, thus freeing up bandwidth for other applications.

This solution will bring a true enterprise Backup/Archive and Disaster Recovery infrastructure to our customers and enable them to benefit from the latest technological advances.

Data Center Consolidation Project Objectives

- Consolidate from 34 Data Centers to 2 Data Centers

- Save $4 million in ongoing costs

- Reduce server counts from 1860 to <400

- Create a true enterprise infrastructure environment

SUN 9990V located
in the SLDC

Campus A Update

With SAN Storage in place at the SLDC – work at Campus "A" is starting to move forward. Our most recent project involved moving the Dept of Commerce servers to the SLDC over the past two weekends. Some problems were found due to older version of ZENworks. To help with the move and solve some log in issues, the new ZENworks 10 client was loaded at Commerce. The final server for the Labor Commission will be moved the week of Dec 7 to 13. All servers for three different data centers will be at the SLDC by the middle of December. This will leave only the DWS Main data center as the only one remaining in Campus A.

Planning and consideration reviews are underway for the major application moves occurring over the next couple of months.

Campus B Update

"Currently there are 43 servers that are now located at the Salt Lake Data Center."

The consolidation of the servers for the DHS Administration Building began in November of last year, 2008. The physical move of all the servers from the DHS Administration building to the Salt Lake data center was completed by September 29, 2009.

Included in this move were NetWare servers, Windows servers, Linux servers and HPUX Unix servers.   There were initially 58 physical and virtual servers that needed to be moved. Currently there are 43 servers that are now located at the Salt Lake Data Center.

The ORS servers from the HK building have also been consolidated and moved to the Salt Lake Data Center. This move involved a total of 14 servers. Having completed the physical move of the servers, virtualization has begun and is nearing completion.

Other sites within Campus B that are being consolidated are Tax, DEQ and DCC. There are a total of 146 servers for these sites combined.

The Utah State Hospital (USH) and Utah State Developmental Center (USDC) are also being consolidated by Campus B. There are 18 servers for these two sites combined.

Campus C Update

"The project goal for the campus is to have all remaining servers that will be moved to the Salt Lake Datacenter converted to virtual machines by December 31, 2009."

Since the beginning of the Datacenter Consolidation Project, Campus C has hosted approximately 249 servers located at the Calvin Rampton, UDOT Traffic Operations Center, UDOT Region 2 Headquarters, and the DPS P.O.S.T datacenters. 35 of the servers at the UDOT Traffic Operations Center have been identified as exclusions from the project due to infrastructure requirements related to the UDOT Advanced Traffic Management System (ATMS). About 75 other servers have been identified as potentially going away by the project deadline due to consolidation efforts or other reasons.

During September and October, UDOT application performance benchmarks were created and recorded. Most of the server performance metrics have been collected. The network architecture plan is complete.   The project goal for the campus is to have all remaining servers that will be moved to the Salt Lake Datacenter converted to virtual machines by December 31, 2009. At this point in time, 79 servers are running as virtual servers and are waiting to be migrated.

The migration strategy for Campus C is to maintain existing network configurations as much as possible and migrate entire server IP subnets simultaneously. For the most part, physical hardware hosting servers for each IP subnet will be moved all at once, while network routes are changed on the state Wide Area Network (WAN). Once the hardware is in place at the Salt Lake Datacenter, servers will be brought up with their original network configurations and should be available for use, minimizing downtime. Virtual servers will then be migrated during the following days to the new infrastructure at the Salt Lake Datacenter.

Data Center Consolidation

Data Center Consolidation

The consolidation continues to move forward. During the next six months we'll will hit the busiest, most complex part of the Project. 238 servers have already been virtualized at the various campuses and are ready to move to the Salt Lake Data Center. Many others will be virtualized within the next 60 days. Plans are being completed and change management planned as Campus technical groups prepare for the migration of these systems. For some of the larger data migrations, we are looking at utilizing consultants equipped with hardware/software services to facilitate the migration of these large data sets.

The new enterprise backup system comprised of Tivoli Storage Manager 6.1 and Data Domain, a data deduplication product, is scheduled to go operational by the first week in February. More information on TSM and how it will be implemented in our new enterprise environment can be found in the TSM article below.

MPLS, (Multiprotocol Label Switching) which helps speeds up network traffic flow and makes it easier to manage, was implemented between DWS and the SLDC. This will allow for a specific subnet to simultaneously exist at DWS and the SLDC. This will enable DWS to move interdependent systems over time while they maintain their same IP addressing, thus lessoning the downtime on their systems and negative impacts on their users.

Data Domain DD880

Project Status

Virtualized but waiting to move	**274**
Servers completed	**583**
Data Centers Completed	**10**
Completed % of work	**31**
Physical Servers (Final Count)	**TBD**

TSM (6.1)

Backups at the State of Utah have traditionally been performed using linear tape. This played a significant role in creating the current backup/archive retention policies we see. This is not an admonishment of tape but more a result of how tape and conventional backup products interacted historically. The process of full, incremental, differential, additional backups was predicated on the desire to free up and reuse tape more efficiently.   This methodology resulted in inefficiencies with duration of the backup, and the amount of resources utilized during the backup/archive process (network bandwidth, memory, CPU, disk, and tape storage, etc.). As we move away from these legacy/archaic forms of understanding and deploying backups/archives, we have the ability to implement data protection procedures based on business requirements. This is a dramatic transition away from the limiting policies and capabilities of proprietary software technology used to provide that protection. What do we really need? What does the business really require? How do we really want our data protected?

Data Center Consolidation Project Objectives

- Consolidate from 34 Data Centers to 2 Data Centers

- Save $4 million in ongoing costs

- Reduce physical server counts from 1700 to 400 or less

- Create a true enterprise infrastructure environment

Quick Update— Storage

As a part of the Data Center consolidation project a new storage system, SUN 9990v and SUN 6780, was installed that will provide storage space for all servers moving to the Salt Lake Data Center. This new storage has been running at peak performance and is not even breaking a sweat at its current 1% CPU/cache utilization.

Currently we have allocated approximately 230 TB of new storage and have almost 80 TB of active data. This active data is comprised of 12 host groups, running on 48 blades with approximately 10 guests per blade. Currently 410 LUNS have been allocated on the SAN.

Campus Capital Update

Working with the Division of Finance, SAP has been migrated from an HP-UX hardware platform to a SuSE Linux VM environment. This saved the Division of Finance from purchasing new PA-RISC or Itanium HP hardware and has shown improvement in the performance of batch processes as well as the Employee Self-Service (ESS) portal for time-entry. Total run-times decreased from over 39 hours to just 3.5 hours.

A number of applications/services have been migrated away from aging and costly Sun Sparc hardware to SuSE Linux virtual servers. SiteMinder UMD authentication is now running entirely from within VMware.

The Governor's Office servers have been relo-cated from the Capitol building to the Salt Lake Data Center.

Among the recently virtualized servers are several shared-hosting Linux+Apache+MySQL+PHP and Linux+Apache+MySQL+Tomcat servers. Between two of these production shared-hosting servers, upwards of 165 unique sites and/or applications are now running in the VM environment.

Users of the GroupWise post-office POA1 had complained for some time that the performance was far from ideal. Shortly after the new SAN environment was put in, POA1 was moved to a virtual server. Feedback has been positive, with many commenting that responsiveness was improved.

> "shown improvement in the performance of batch processes as well as the Employee Self-Service (ESS) portal for time-entry. Total run-times decreased from over 39 hours to just 3.5 hours"

Campus Rural Update

The Data Center consolidation project does include Data Centers located in the Rural areas of the State. With a Datacenter being defined as any site with three or more servers, six locations have been identified: Provo Regional Center, Ogden Regional Center, Clearfield West UDOT Regional 1 (Ogden), UDOT Region 3 (Orem) and UDOT Region 4 (Richfield).

Capacity planning for the servers at the three UDOT regional offices has been accomplished and suitable hardware has been ordered. Richfield originally had nine servers (two Novell and seven Windows). With consolidation and other efforts that number has been reduced to six. The Orem location has six servers and Ogden has five servers. When consolidation and virtualization is com-pleted, each location will have one server running one virtual host with four server instances (Windows and Novell) and one backup server. This is on target to be completed by May 1st.

With some planned networking upgrades it is anticipated that the UDOT regional offices will participate in the enterprise IBM Tivoli Storage Management solution and the Backup servers at these locations will be eliminated.

Areas outside of UDOT's headquarters are using an internet content filtering product called Surf Control. It was discovered that the Enterprise filtering solution that DTS has implemented can provide UDOT management with the same detailed information. By utilizing the Enterprise content filtering solution a savings of $41,000 per year will be realized.

> "By utilizing the Enterprise content filtering solution a savings of $41,000 per year will be realized."
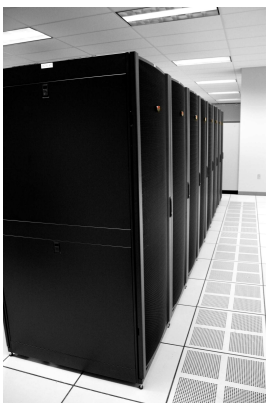
Salt Lake Data Center

Campus D Update

The Consolidation project in Campus D originally targeted 254 servers in 4 data centers. By combining some applications and by the elimination of others the server count has been reduced to 165 and will continue to be reduced through further consolidation efforts.

All services provided by IBM-AIX and HPUX UNIX servers have been migrated to SLES Linux servers reducing maintenance costs and easing the migration to VMware at the SLDC. In addition server replacement costs will be greatly reduced.

In December a consultant was hired to assist in the virtualization process at Campus D. His expertise was drawn upon to resolve several problematic systems, including the virtualization of Windows Active Directory Domain Controllers as well as solve other virtualization issues.

At this time there are 58 active virtual clients running on the ESX servers in the CHB data center and 21 at the SLDC. Physical moves of servers will begin in February and all Campus data center consolidation efforts will be completed by May.

TSM (6.1) cont.

How TSM works

> "The business, first and foremost, wants all active data to be protected. TSM considers all data that currently exists on a client workstation or server to be active. Active data is never deleted."

Attached disk DD880

TSM accomplishes its' desired results by performing an initial full backup and then implementing progressive incremental backups thereafter.

The business, first and foremost, wants all active data to be protected. TSM considers all data that currently exists on a client workstation or server to be active. Active data is never deleted.

Beyond this, business needs will vary. An important concept is that TSM considers all data deleted and not currently on a client workstation or server, to be inactive. When keeping multiple versions of the same file, TSM only keeps the most recent version of the file as active. There are four main criteria to be looked at within TSM to meet business needs.

- How many versions of data that currently exist on the client workstation or server does the business wish to keep? The last version is considered active and all others are inactive.

- How many versions of data deleted from a client does the business wish to keep? All of these are considered inactive.

- How long should inactive data be kept for business needs? Remember that this includes all but the most recent active version of data that exists on the client workstation or server.

- How long should the last version of data (modified date closest to current) that has been deleted from the client be kept? It is important to note that TSM will no longer have the ability to restore this non-active version of data after this retention period is reached.

These attributes are set up in TSM policies. Individual files/directories can be bound to different policies. This kind of flexibility allows for tailored business needs. Point in time, ad-hoc, database and archive backups can all be dealt with as needed. Other properties such as copy destination, how to handle open files, and disaster recovery copies are also policy driven.

These areas and others provide a design that allows TSM to move beyond backup and achieve actual storage management.

Data Center Consolidation

HP Blade System

Data Center Consolidation

The Data Center Consolidation project is on schedule, with some of the most critical and most technical work scheduled to occur over the next couple of months, with email and database servers making up some of the servers that will physically be moved to the Salt Lake Data Center. This involves tight coordination between both the SLDC and the individual Campuses that will be moving the equipment. Much planning has occurred behind the scenes preparing the SLDC to receive servers as well as other IT equipment. Enhancements have been made to the cabling plant and additional power capacity has been increased to provide the required resources needed to support the additional equipment.

As the physical server migrations continue, the virtual moves are occurring at an accelerated pace. Over the past few months the Campuses and the Capitol campus have been busy converting servers from physical servers to virtual servers, referred to as P2V (Physical to Virtual). On the scheduled move dates these VM's will be migrated from their existing data center to the SLDC. Upon a successful move, the VM's will be placed into production and the physical server turned off. The technical team has been successful in achieving a physical to consolidation ratio of 10-12 virtual server instances per single blade, thus eliminating 9-11 physical servers in the process.

One of the milestones reached in the Month of February is passing the 50% completions mark. It has taken a lot of planning and hard work to accomplish this task.

Project Status

Virtualized but waiting to move	**224**
Servers completed	**987**
Data Centers Completed	**11**
Completed % of work	**53**
Physical Servers (Final Count)	**TBD**

Blade Systems

DTS Enterprise hosting has chosen the Hewlett Packard Blade Systems as the Blade servers of choice. Five fully configured Blade systems have been purchased and are configured to house Agency Virtual server instances.

The advantages of using blades instead of stand alone servers are many, including:

1 More efficient use of system resources. IG. Memory, CPU.

2. Smaller footprint in the data center.

3. Easily be clustered for enterprise critical applications.

4. Reduced power consumption.

5. Reduced cabling complexity

6. Easy to install and replace

7. Redundancy built in such as, power supplies, dual back plane paths, dual vlans, fans etc.

Our Customers will benefit from the combination of Blade Systems and VMWare to enable the hosting environment to be both fault tolerant and able to evolve with the changing needs of our customers and the enterprise.

Data Center Consolidation Project Objectives

- Consolidate from 34 Data Centers to 2 Data Centers

- Save $4 million in ongoing costs

- Reduce physical server counts from 1700 to 400 or less

- Create a true enterprise infrastructure environment

Quick Update— TSM Training

On Tuesday February 23rd, the Storage and Backup Team offered a Tivoli Storage Manager (TSM) training class for the Hosting system administrators. The training was well attended. In efforts to make the training widely available, the training was webcast and is currently available for viewing at

http://www.ustream.tv/channel/nui

Campus A Update

With over 130 servers moved to the SLDC, Campus A consolidation efforts are making significant progress. At this point, the Campus A hosting team has moved 83 servers into the SLDC Virtual Infrastructure with another 17 servers virtualized at the DWS Admin North Data Center ready to move.

Recent milestones include conversion of a Sun data warehouse server to Linux. Greg Nelson, the data warehouse manager, is very impressed with the performance of their new hardware. Moving to a X86 Linux server has not only increased service to the agency, but also will save the department money on service and support that used to be paid out for

the expensive and proprietary Sun Hardware.

Business plans are being developed to complete a migration of several additional systems from Sun Hardware to Linux that will be carried out in FY2011. This long-term project will continue to save the department money.

Campus A Hosting supervisor, Chris Kunde, would like to thank all of those who have helped assist his team with recent physical server moves, namely, Dan Gallegos and crew. Their dedication to the data center consolidation project has enhanced our ability to meet our deadlines.

> "Greg Nelson, the data warehouse manager, is very impressed with the performance of their new hardware."

Campus B Update

The consolidation efforts for the Department of Community and Culture (DCC) located at 250 N. 1950 W. were successfully completed the first week of February. Six servers were virtualized and/or consolidated to the Salt Lake Data Center.

DEQ is also nearing completion with much of the data and all of their databases having been moved to the SL data center.

The Tax department is well into the consolidation. 49 virtual servers have been created at the SL data center and are being prepared to be transitioned into production. Among these are the Motor Vehicle servers. Some preliminary load and speed tests have been and continue to be performed against the new virtual servers at the SLDC. The results

of the limited preliminary tests have shown an increase of approximately 20 to 30 percent in performance over that of the existing hardware. The Motor Vehicle servers are also being transitioned to Linux from HP-UX, which will result in an on-going cost savings.

There is also much work being performed in preparing for the consolidation efforts for Utah State Hospital (USH) and Utah State Developmental Center (USDC). VPNs have been put into place to protect data while in transit. Database enhancements are also currently being made by the business in order to optimize database performance across the WAN. Speed tests after initial database modifications have shown an increase in performance.

> "shown an increase of approximately 20 to 30 percent in performance over that of the existing hardware."

StorageTek Backup
Tape Library

Campus C Update

During the past two months, Campus C hosting has focused efforts on finalizing plans for the remaining UDOT and DPS servers located at campus datacenters. With a few exceptions, the UDOT and DPS servers moving to the Salt Lake Datacenter have all been virtualized. To date, 101 servers that will or have been migrated are virtual. A lot of effort is also being spent in campus service consolidation or migration prior to the migration of production systems.

The 32 support, development, and test servers (that will remain after project completion) have been relocated to the Salt Lake Datacenter. In doing so, the support group has been able to identify potential issues for production systems and are working through resolution processes without a major impact to agency customers.

The current plan is to immediately begin migrating production UDOT and DPS systems once the legislative session has ended in hope of completing all Campus C server migrations by the target date of March 31st.

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DTS
DEPARTMENT OF TECHNOLOGY SERVICES

Data Center Consolidation

Issue 5 **March, 2010**

Data Center Consolidation

The Campus C move has been one of the most anticipated moves of the Data Center Consolidation project. The plan was to migrate 62 Virtual servers and 12 physical servers to the Salt Lake Data Center on the same day. Falconstor replication technology was used to facilitate the migration of virtual machines and data to the Salt Lake Data Center prior to the cut over weekend. Other smaller UDOT servers were migrated previous to this move to reduce the number of servers that would need to move on the big weekend. Planning included Campus Infrastructure staff, Application Development staff and key business customers. Each of these separate groups had the responsibility to perform testing to ensure that the applications worked as expected before and after they were moved.

After many hours of preparatory work, most occurring in the days and weeks leading up to the actual move date, the move/migration began on March 20, 2010. At 6:00 AM, the targeted physical servers were powered off and prepared for transport to the Salt Lake Data Center. At the same time the physical server move was occurring, the final data updates for the virtual environment were being replicated to the SLDC. Then both the physical and virtual servers were brought up in a pre-determined order based on priority to either the business or technical staff. Once each system was up and available the testing process began. A master checklist which could be accessed by both the System Administrators and the Application Developers was centrally maintained to track project progress. As each application was tested and determined to be performing adequately, it was updated on the checklist and a regular status was communicated to both DTS and Agency Business management. Key business customers were then able to test the applications to ensure that it was working to their expectations.

By 9:30 PM most all applications had been signed off as working by the Application Developers and most had been tested and verified by business customers as well. Those remaining applications that were not able to be tested on Saturday were approved to be tested on the following Monday.

It was a combined effort of all DTS staff at Campus C that helped make this so successful and virtually transparent to the Agency customers.

Removing servers at Campus C

Project Status

Virtualized but waiting to move	**147**
Servers completed	**1241**
Data Centers Completed	**12**
Completed % of work	**67**
Physical Servers (Final Count)	**TBD**

Message from the CIO and COO

We have made significant strides in completing the Data Center Consolidation Project. We are now at 67% complete, which is in line with our goal of completing the project by June 30, 2010. We know that many DTS employees are working around the clock to successfully complete phases of the project. Your efforts have been outstanding and are greatly appreciated. There have been many successful accomplishments throughout the project, including the recently completed Campus C move. We appreciate the hard work and dedication that you have put forth in trou-bleshooting problems in order to effectively minimize the impact to our customers. Thank you to all DTS employees involved with the project.

-Steve and Ken

Data Center Consolidation Project Objectives

- Consolidate from 34 Data Centers to 2 Data Centers

- Save $4 million in ongoing costs

- Reduce physical server counts from 1700 to 400 or less

- Create a true enterprise infrastructure environment

Campus D Update

Campus D continues to make progress towards Data Center Consolidation completion with over 100 servers virtualized and/or moved to the SLDC and another 20 virtualized waiting to move.

In February, Campus D's hosting staff moved three "N-Tiered"systems that supply remote applications to users throughout the state. These systems rely upon P2P-VPN connections with outside entities for bi-directional message exchange. These services were successfully re-created at the Salt Lake Data Center, thanks to the work of Jordy Davis and Kelli Okumura, and provided a nearly seamless transition from the VPN concentrator at the

> "the users affected by these moves indicated a perceivable 20-30% performance increase"

Canon Health Building. The initial reports received from the users affected by these moves indicated a perceivable 20-30% performance increase accessing data files on the VM's versus that of the physical server, and an overall application performance improvement.

The consolidation effort thus far has only required the transfer of 5 physical servers to the SLDC but several more are scheduled for the end of March and throughout April. The physical server moves have gone relatively smoothly thanks to the help provided by Dan Gallegos and Doug Munson at the Salt Lake Data Center.

Corrections Campus Update

The nature of the computing environment, along with the diverse needs of our customers at the Department of Corrections, have led to unique challenges as well as opportunities in its consolidation efforts. The Department had moved to a virtual computing environment on HP blade servers a few years ago. This prior experience with blade and virtual server environments meant that the DTS hosting staff located at Corrections was already versed in the technology required for the consolidation effort. The fact that nearly half of the 53 servers that needed to be consolidated to the Salt Lake Data Center were already in a virtual environment also gave the staff an advantage in the task of moving the servers to the SLDC virtual infrastructure.

Challenges presented themselves in the

> "moves of 21 servers and combined or eliminated 3 more with minimal impact to the department's operation."

timing and coordination of the individual server moves. Unlike some areas, the Department of Corrections has many multi-purpose servers that accommodate several divisions, all with varying schedules and uptime needs. The department has several 24 X 7 areas, as well as areas that do not participate in the 4 day/ten hour work schedule followed by most of the executive branch agencies. Coordination of server moves was, by far, more challenging than the technical aspect of the migrations.

To date, the hosting staff has been able to accomplish the moves of 21 servers and combined or eliminated 3 more with minimal impact to the department's operation.

Two servers hosting GroupWise will be physically moved to the data center and plans are being currently being developed for the final, mission critical server moves.

Capitol Campus Update

The Capitol campus has made significant progress over the past couple of months. Currently 53% of the servers have been virtulalized in the Salt Lake Data Center.

Web browsing last month was slower then normal. This was due to 8e6 banner blocking

and the abundance of banners on the web. We needed to increase the speed and isolate this function from our everyday Siteminder policy server traffic. This was accomplished by Virtualizing the banner blocking application with a Policy server hosted on the same Virtual host we gained 2000% in performance.

Campus C move, installing servers in the SLDC

Data Center Upgrades

With 23 data centers consolidating into the Salt Lake Data Center (SLDC) the infrastructure has had to grow and adjust to meet the demand of the consolidation project. The SLDC is approximately 22,000 square ft. with 10,900 square ft. of raised floor for hosting server racks and other computing equipment. The following are a few enhancements that have occurred and are being worked on to improve the infrastructure.

- Approximately 46 new racks have been added in the SLDC, which gives DTS an estimated 132 total racks for hosting IT equipment. Each rack or row of racks require power, fiber, copper connections for network, cable tray for cable management, and network switches for network connectivity.

Data Center Upgrades cont.

"The finished project is estimated to save the combined State agencies 14.7 billion BTU's of energy per year. "

Preparing for the move

- Added four (4), 480 volt /150 kVA PDU's (power distribution units) to provide power required for the new racks and IT equipment. The Netbotz equipment that provides video surveillance, humidity detection, and temperature monitoring will also be upgraded. Additional cameras and sensors will be added in the SLDC and Richfield Data Centers to improve the security and environmental monitoring of both facilities.

With all of the equipment coming into the SLDC, options to improve the efficiency are being looked at. DTS and DFCM have collaborated on a project to improve the efficiency and lessen the environmental impact for heating and cooling of the SLDC and Capitol Campus.

Because of the high loads of electrical energy used in the SLDC, large amounts of heat are generated and need to be cooled. The cooling process currently ejects 17.3 billion BTU's of waste heat to the atmosphere every year. DTS is working with the DFCM to take the waste heat and provide heating to the Capitol Campus for approximately 9 months of the year. By transferring the waste heat from the SLDC to the Capitol Campus, both DTS and DFCM will save energy.

The finished project is estimated to save the combined State agencies 14.7 billion BTU's of energy per year. That is enough energy to heat 95 homes for one year. The project will help the environment by reducing green house gases by 735 metric tons per year.

Additional improvements to the SLDC are improving airflow distribution; this measure allows fan savings to be realized by installing physical barriers to separate the cold aisles (on the intake side of the servers) from the hot aisles (on the outlet side of the servers). By keeping the hot and cold air from mixing, the data center can be cooled with warmer supply air, and the CRAC (computer room air conditioners) units can cool the same number of servers with less air. All of the improvements should significantly improve the efficiency and lower costs within the SLDC.

Data Center Consolidation

Issue 6 **April, 2010**

Data Center Consolidation

The Capitol Campus has made much progress over the last few months. Unlike the other Campuses who have been tasked with both virtualization and moving their servers to the Salt Lake Data Center, their main task will be to virtualize the various servers within the Salt Lake Data Center. They have two to three times the number of servers as a typical campus. This has been a formidable task in addition to maintaining the normal day to day workload. Additionally, they are called upon to assist the other campus technicians to move their servers, both physical and virtual, to the hill.

The Capitol campus consists of not only the main Salt Lake Data Center (609 servers) but also the Governor's office (17 servers), DHRM (23 servers), Finance (14 servers), and finally the Richfield Data Center (73 servers). Geographically they're all located on the hill with the exception being the Richfield location. Additionally, various agencies house servers at the Salt Lake Data Center that have been both maintained and administrated by the Capitol hosting group. Generally the server virtualizations will be performed by the Capitol hosting group.

Each of the different data centers on the hill present different challenges. For example, the servers in the Governor's office were physically moved to the hill so as to not cause any disruptions during the past legislative session. These servers are now waiting to be virtualized if appropriate.

A number of the servers in the Division of Finance have been completed. Systems have been migrated from more expensive platforms, for example, HPUX and moved to Linux and Intel x86 based servers. Not only is this less costly to maintain and replace but they have seen significant performance gains as well. The DHRM server move and virtualization endeavor is complete.

The Richfield Data Center is one of the two official data centers that will remain when the project is complete. A limited amount of virtualization has occurred with more being planned. Currently major infrastructure upgrades are in the process of being implemented.

This has been a huge undertaking by the Capitol Hosting group. The shear numbers of servers and the complexity of dealing with various agencies has certainly been a challenging yet rewarding endeavor.

The Salt Lake Data Center

Project Status

Virtualized but waiting to move	**131**
Servers completed	**1341**
Data Centers Completed	**14**
Completed % of work	**70**
Physical Servers (Current Count)	**570**

Over the past month due to various storage issues, virtual moves to the Salt Lake Data Center were put on hold. It was agreed that SCSI timeouts and performance issues needed to be dealt with and corrected before any additional data was moved to the enterprise SAN. According to the vendor who did the configuration on the SAN, it was originally set up to be IOPS (Input/Output operations per second) intensive. While beneficial to some applications it was not performing adequately for the majority of the applications. A process called interleaving was implemented that will enable the controllers to read and

write data without waiting for or notifying the other controllers; thus speeding up data access. Over the last three weeks technicians from both SUN and Hitachi as well as LSI (equipment manufacturer) have been on site working through the reconfiguration of the disk pools. This required a migration of all data from the current location to a new location all without incurring any downtime to our customers. The changes were made and the predicted performance increases were realized. Migrations have since resumed. Despite the setback the project remains on schedule.

Data Center Consolidation Project Objectives

- Consolidate from 34 Data Centers to 2 Data Centers

- Save $4 million in ongoing costs

- Reduce physical server counts from 1700 to 400 or less

- Create a true enterprise infrastructure environment

DTS
DEPARTMENT OF TECHNOLOGY SERVICES

Data Center Consolidation

Issue 7   **May, 2010**

Data Center Consolidation

A couple of major project milestones were reached during the month of May. First, the last of the servers in Campus C were virtualized/moved to the Salt Lake Data Center. This involved data centers from the Department of Public Safety, both the Rampton and Post data centers, as well as UDOT data centers located at the Traffic Operation Center and the UDOT Region 2 location. Second, both Corrections data centers located in Draper and Gunnison were completed with the last of their servers being virtualized/moved to the Salt Lake Data Center.

Great strides were made in the other campuses as well. Campus A has completed all servers except those located in the DWS Main data center. They are on target for completion by the end of May. Campus B successfully moved the Motor Vehicle application to the Salt Lake Data Center and customers are reporting good performance. They are on target to complete their server moves when the remainder of the Gentax system moves on June 25th. Campus D made progress towards meeting their completion target dates. They completed a total of 45 servers during the month of May and are planning to complete all server virtualization/moves over the next couple of weeks. It is anticipated that the Rural Campus will be completed by the end of May. Capitol Campus spent the month of April continuing to virtualize servers already located in the Salt Lake and Richfield Data Centers. They were able to complete an additional 125 servers during the month of May.

In all, an additional 345 servers were completed this month. 345 represents the highest number of servers completed in any one month. Currently the project stands at 90% complete which is up from 70% from the previous month. Data Centers completed through the month of April was 14. By the end of May that total has increased to a total of 23 completed Data Centers.

The Salt Lake Data Center

Project Status

Virtualized but waiting to move	89
Servers completed	1686
Data Centers Completed (35 Total)	23
Completed % of work	90
Physical Servers (Current Count)	570

Storage Optimization

It has proven to be a challenge to integrate the new SAN into the State of Utah's complex and varied environment.

When the SAN was first implemented, a high throughput configuration was used to optimize storage to work for the anticipated data types being moved to the new SAN. Unfortunately these configurations proved to be inadequate. Experts were consulted for recommendations for configurations that would both increase performance and eliminate downtime. While those newly implemented changes were beneficial and performance gains were realized, some performance and timeout issues remained. Once again experts were consulted and additional recommendations were implemented. One of those recommendations was utilizing "Write Cache" on the SUN 9990v. It was decided to turn on write cache for applications that would benefit from using it. Performance gains were realized immediately. Further testing will be performed to validate these early successes.

In addition to the write cache activation, 60TB of Tier 1 fiber channel disk as well as 60GB of additional cache has been ordered to be installed in the 9990v. We will be following the recommendation of using the 9990v as tier 1 storage. The other fiber channel storage on the SUN 6780 and SAS disk on the Hitachi AMS 2500 will be considered tier 2 storage. The remaining SATA disk on the 6780's will be used as tier 3 storage.

Data Center Consolidation Project Objectives

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Campus Update Rural

> "Region 4 UDOT has gone from nine physical servers to two physical servers."

Richfield UDOT (Region 4) finalized virtual services in March when new hardware for the virtualization was put in place. All services other than server backups are running on virtual servers. CADD, Plotting, and data storage are just a few of the applications that have been virtualized. Region 4 UDOT has gone from nine physical servers to two physical servers.

Orem UDOT (Region 3) was completed on April 16th with the physical to virtual conversion of two Engineering servers. This completed a consolidation from six physical servers to two physical servers.

Ogden UDOT Data Center (Region 1) consolidation was completed the following week on April 23rd with much the same work as Orem. Ogden UDOT went from four physical servers to two physical servers.

To complete the Rural Data Center consolidation a service located at the Ogden Regional Center is being migrated to the SL Data Center. The application had previously been updated to a Web App, but previous history was unavailable from that application. The historical data will be loaded onto the new pervasive server at the capitol. This should all be accomplished by the end of May.

Campus C Update

> "Campus C Infrastructure successfully completed its Data Center Consolidation tasks in bravado fashion"

After numerous long nights, short timelines and unfathomable expectations between emergency application upgrades, performance woes and normal agency activities, Campus C Infrastructure successfully completed its Data Center Consolidation tasks in bravado fashion, with verve and tack; encountering insurmountable hurdles which were dealt with as if lowly speed bumps by a terrific bunch of techs.

Starting out with 248 servers, the Infrastructure staff managed to consolidate services and application offerings, ultimately eliminating 64 servers for the entire Campus. The remaining systems were either virtualized (168 Servers) or simply relocated physically to the Datacenter due to licensing or scope restrictions.

Thanks to Dan Gallegos and his entire staff, whom were completely professional and of the highest caliber to work with. Also thanks to Roger Bishop and his staff for all of their efforts under less than ideal circumstances. A resounding thanks to the Project Managers whose guidance and direction are without measure, particularly their willingness to fight the fight on all fronts. Lastly, to the agencies which we support for their tolerance under a difficult set of circumstances.

Campus Update Corrections

> "Throughout the process, DTS received a great deal of support from the upper management and staff at the department."

The Consolidation of the servers from the Department of Corrections data centers was completed on April 24th with the physical move of two GroupWise post office servers to the Salt Lake Data Center. The project was seen as a success from both the DTS perspective as well as from the customer's perspective. Despite 24 X 7, the nature of the computing environment as well as the diverse needs of different areas within Corrections, consolidation of the server environment went relatively smoothly. This was due to prior experience with the blade, a virtual server environment that the DTS hosting staff at Corrections possessed, as well as the strong support and cooperation from the customer themselves. Challenges that presented themselves in the timing and coordination of the individual server moves were addressed through the coordinated efforts of the DTS hosting team and management along with the management and staff at Corrections. Throughout the process, DTS received a great deal of support from the upper management and staff at the department. It was that mutual cooperation and support that lead to the success of the project. The remainder of the department's blade server environment will be addressed in a second phase to be completed by June of 2011. The DTS hosting team looks forward to phase II of the consolidation project.

Data Center Consolidation

Data Center Consolidation Project Completion

In early January 2009, planning began for the Data Center Consolidation project. Time was spent gathering information that would help in the planning of the overall project. Information gathered from other States that have attempted consolidation proved to be very beneficial. Consistent and meaningful communication with all entities associated with the consolidation was deemed most important to the States that were interviewed. At the time none of the States solicited had successfully completed a data center consolidation.

The project team was given a very aggressive time line as well as a limited budget. As the planning process commenced it became evident that the current enterprise infrastructure environment would not be able to support the project objectives. Additional equipment would need to be purchased, as well as older technologies replaced by the latest technologies. Organizational changes occurred as well. Changes to the organization of the Hosting group were made to help optimize the reporting structure. This made it easier to give direction and communicate to those in the hosting group. This was a pivotal change that proved extremely beneficial to the eventual success of the project.

Meetings were planned with vendors to discuss the various project objectives. The consensus among the various vendors was to use consultants and create Swat Teams that would actually perform the consolidation at each of the data center locations. One of the inherent problems with the Swat Team approach was the Teams' unfamiliarity with the Agency Systems and Applications. We considered their recommendation but eventually it was decided that we would get better results using our own technicians. Even though the consolidation was in a large part completed by DTS staff, Vendors and Consultants surely played a part in helping us to complete the project within scope, schedule and budget. Some vendors exceeded our expectations in pro-

viding excellent products, aggressive pricing and sage advice.

The end of the Data Center Consolidation Project has arrived. It's been eighteen months since the beginning of the project. Many DTS technicians, managers, application developers, and DBA's worked long nights and many weekends on the Consolidation Project. Most have passed up vacations and time off to stay dedicated to completing the Consolidation effort. There were certainly ups and downs but amazingly everyone held it together and stayed the course to the end.

An ambitious goal 18 months ago was realized in the final week with the completion of the GenTax servers as well as a few virtualizations that occurred on June 29th. In the end a 100% completion was accomplished.

We appreciate all those in DTS who participated in the consolidation effort and all of their hard work and dedication in getting this project completed and doing it in a way that minimized the negative impact to our customers.

Thanks to Senior management for entrusting us with such an important project as well as providing the proper amount of support and leadership. A special thanks to the Campus Team leads, Hosting Supervisors and System Administrators who made it happen day in and day out. They deserve a lot of the credit for completing the project, and all while still doing their regular day jobs.

It was truly a team effort. Without everyone's contributions the Data Center Consolidation's goals would not have been realized. The fact that 100% completion was achieved is a tribute to the dedication and perseverance of the people we have working within DTS.

The Salt Lake Data Center

Project Status (Final Numbers)

Virtualized but waiting to move	0
Servers completed	1864
Data Centers Completed (35 Total)	35
Completed % of work	100
Physical Servers (Final Count)	591

Data Center Consolidation Project Objectives

- Consolidate from 35 Data Centers to 2 Data Centers

- Save $4 million in ongoing costs

- Reduce physical server counts from 1700 to 400 or less

- Create a true enterprise infrastructure environment

Campus A Update

> "Campus A has completed the consolidation of four data centers and more then 300 servers"

So here we are at the end of the Consolidation project. Hundreds of servers, man-hours and Mt. Dews later, Campus A has completed the consolidation of four data centers and more than 300 servers. The Technicians of Campus A put in much work. Every member played their part to make sure the project was completed successfully.

The Campus A Hosting Supervisor Chris Kunde and Campus A DCC Project Manager James Kammeyer would like to thank follow-ing staff for all their hard work, efforts, sacrifice and maintaining good humor throughout: Jeff Bartholomew, Dave Sedei, Brant Davis, Tom Carney, Keith Scholl, Doug Larsen, Eric Swain, Dan Rawson, Janis Race-Bigelow, Campus A Desktop Support, Roger Bishop, Tony Hancock, Doug Munson, Dan Gallegos, Charmaine Malan, Dean Larsen, Shawn Lowry and Richard Langford. Darrus, Tim, Greg and Nick are no longer strangers to the staff here at Campus A.

Campus B Update

> "There have been many of these examples with each department that demonstrate the cooperation and coordinated effort…"

The Data Center and Server Consolidation project has been completed for Campus B. It was an ambitious endeavor and very challanging due to the complexity of the systems within the various Agencies with the Campus. The server consolidation efforts for campus B have included the following departments:

Department of Human Services (DHS) Administration Building

DHS - Office of Recovery Services (ORS) HK Building

DHS -Utah State Developmental Center (USDC)

DHS - Utah State Hospital (USH)

Department of Community and Culture (DCC)

Department of Environmental Quality (DEQ)

Utah State Tax Commission

Along with the successful consolidation of the servers for these departments there were several major applications that have also been consolidated to the Salt Lake Data Center. These applications include SAFE, Motor Vehicles, Gentax, DEQ's Documentum, KLAS, Webgrants and eChart. In fact, Gentax was just recently completed. Gentax is the Tax Commission's mission critical application for processing all major tax systems for the state. The transition of this entire system to the Salt Lake Data Center was performed in such a way that minimized and managed down time efficiently as well as facilitating a much smoother transition. The plan for the Gentax transition was conceived, developed and implemented by the Gentax development team who worked with DTS to make it happen. There have been many of these examples with each department that demonstrate the cooperation and coordinated effort that has occurred within Campus B.

The success of this consolidation effort is due to the dedication and hard work of many people from several different functional DTS groups from the Capitol and Campus B, as well as from the several DBA/development groups from the departments that were involved in the consolidation. We offer our thanks and appreciation in recognition of their dedication and hard work to accomplish this goal.

Campus C Update

> "Ultimately eliminating 64 servers for the entire campus"

During the month of May, the last of the servers in Campus C were virtualized/moved to the Salt Lake Data Center. This involved data centers from the Department of Public Safety, both the Rampton and Post data centers, as well as UDOT data centers located at the Traffic Operation Center and the UDOT Region 2 location. Both Corrections data centers located in Draper and Gunnison were completed with the last of their servers being virtualized/moved to the Salt Lake Data Center. Starting out with 248 servers, the Infrastructure staff managed to consolidate services and application offerings, ultimately eliminating 64 servers for the entire Campus. The remaining systems were either virtualized (168 Servers) or simply relocated physically to the Datacenter due to licensing or scope restrictions.

Thanks to Dan Gallegos and his entire staff, whom were completely professional and of the highest caliber.

Campus D Update

> "...the project began with a target of over 250 servers spread across 4 data centers."

Work on the Data Center Consolidation Project at Campus-D was completed in June. The project has been deemed a success and that relates directly to the team work that was shown by DTS and Agency staff throughout the project. Campus-D hosting staff sacrificed weekends, vacations and time with their families to ensure the success of the project. To their credit, the project began with a target of over 250 servers spread across 4 datacenters. 96 servers were retired or their services were consolidated to other servers, 130 servers were virtualized then moved to the SLDC, 21 servers that could not be virtualized were physically moved to the SLDC and 20 new servers were created at the SLDC which resulted in a significant hardware-savings for the Agency Programs.

It should be noted that the following DTS staff played special roles for Campus-D in this project and their efforts are greatly appreciated:

Terry Forsgren-Campus D Project Lead

Shawn Goble-Campus-D hosting

Benjamin Goodrich-Campus-D hosting

Tony Larsen-Campus-D hosting

Andre Musgrow-Campus-D hosting

Steven Schiess-Campus-D hosting /DNR Program Support

Ellis Wood-Campus-D hosting

Kevin Perry-Campus-D hosting/ Desktop Support

Jordy Davis-Campus-D Networking

Chris Pratt-USIIS Project Manager

Dustin Crump-Campus-D hosting/Desktop Support

Dusty Serr-Campus-D hosting/Desktop Support

Doug Brown-Campus-D Desktop Support

Eldon Jenson-Campus-D Desktop Support

Jim Howard-Campus-D Manager

Joe Cohen-IT Director for Health

Greg Mead-IT Director for Natural Resources

David Willis-IT Director for Alcoholic Beverage Control

Ken Gee-IT Director for Agriculture

Jonathan Foster-VM sub-team lead

Steve Assmussen-Contract Consultant

Dan Gallegos-SLDC data center management

Doug Munson-SLDC data center management