Colorado Department of Revenue
Infrastructure Refresh

Nomination Category	Improving State Operations
State	Colorado
Project Initiation Date	January 2013
Project Completion Date	December 2014

I. EXECUTIVE SUMMARY

In December 2014 the Governor's Office of Information Technology (OIT) completed the Infrastructure Modernization initiative for the Colorado Department of Revenue (DOR) -- an incredible project that completely upgraded DOR's systems and service, resulting in faster service and greater accuracy.

This Infrastructure Modernization initiative had two major project components:

1. Upgrade and virtualization of a major, mission critical system (CSTARS)
2. System Infrastructure Refresh (SIR) project

The Infrastructure Modernization initiative transformed DOR's aging -- and increasingly unreliable -- computer systems into a stable, modern and sustainable environment. The initiative leveraged a virtualization strategy offering a number of benefits of a robust modern architecture, including:

- Reliability, scalability and sustainability
- Compliance with cyber security requirements
- Ability to upgrade and migrate applications to the optimal platforms
- Standardization and functionality not available with the old systems
- The Infrastructure Modernization initiative was the single largest, non-enterprise, improvement in infrastructure deployed since OIT's statewide information technology (IT) consolidation in 2008.
- Colorado Department of Revenue (DOR) firewalls and associated network security protocols were completely redesigned and stabilized for the first time in Colorado history.
- Virtualization enabled the consolidation of up to 10 existing servers into one, resulting in avoiding acquisition costs and reducing physical footprint and energy consumed.

The Infrastructure Modernization initiative was a huge move to a new architecture that is more powerful, flexible, agile, compatible with the state's IT direction.

II. PROJECT NARRATIVE

a. Concept

The Infrastructure Modernization project was the upgrade and virtualization of the servers and database system behind the Colorado State Title and Registration System (CSTARS).

- CSTARS is critical to the residents of Colorado as it processes all vehicle titles and registrations in Colorado's 64 county offices and 42 branch offices.
- 155 data tables, containing more than one billion records, were migrated from obsolete hardware onto a new, virtual database of approximately 600 gigabytes.

The SIR project replaced core network units that were more than 15 years old and required the manual programming of routing protocols. This involved replacing and/or upgrading approximately 70 switches (including core switch) in multiple office locations and data centers, increasing throughput capability to 10 Gbps, and implementing a Virtual Routing and Forwarding (VRF) model and changing data flow to allow for increased scalability, configurability and ease of implementing/maintaining security controls.

- The project modernized the core data network infrastructure, facilitated the migration of mission-critical DOR applications (including the state's core tax system, sales tax analysis and sales tax calculator; and the motor vehicle renew by mail, emissions and accident reporting, among others) to a functional, virtualized network infrastructure environment, and implemented security control consistent with state standards and security best practices.
- More than 30 critical and essential applications were successfully moved to the virtual environment.
- More than 200 servers were decommissioned.
- Reliable, high performance connectivity was established for DOR systems.

There are two data centers, and both were upgraded as part of this infrastructure refresh. One data center now has a new cloud with up to four times more power than the previous environment. It's Cisco Unified Computing System has 32 blades, 448 cores, 5.5 TB RAM, 10 GB interconnects, and 300 TB new storage. It's backup storage, EMC Isilon with 400 raw TB, now provides additional capacity for existing HP and HDS units, and ultimately helps to replace them.

The second data center's infrastructure was replaced entirely by a Cisco Unified Computer System with 8 blades, 90 cores, 737 GB RAM, 10 GB interconnects,

and 300 TB new backup storage. For storage, it has a 400 TB EMC Isilon.

b. Significance

One of the key components of this first-of-its-kind migration was the use of virtual servers. Virtualization offers the benefits of a robust modern architecture that:

- Is scalable and sustainable
- Is compliant with cyber security requirements
- Enables the department to upgrade and migrate applications to the most optimal platforms
- Provides standardization and functionality currently not available with present systems
- Redesigned and stabilized DOR firewalls and associated network security protocols for the first time in Colorado history
- Enabled the consolidation of up to 10 existing servers into one, resulting in avoiding acquisition costs and reducing physical footprint and energy consumed

This was the biggest such effort at the State of Colorado to date. It required a specific funding request to the legislature and all hands on deck between the Colorado Department of Revenue and the Governor's Office of Information Technology, making it a true example of how state government can improve services offered to it's residents by collaborating.

It has enabled the more rapid delivery of new services. By moving to a virtual environment, adding more systems is a much easier process. Those systems can then support new applications and databases moving forward. The business opportunities are tremendous: With benefits of a robust modern architecture, including reliability, scalability and sustainability, compliance with cyber security requirements, ability to upgrade and migrate applications to the optimal platforms, and standardization and functionality not available with the old systems.

After the completion of the Infrastructure Modernization initiative, OIT expanded this innovation to build out other similar solutions for the State of Colorado. One example is that the technology is now being used to support the state's Department of Personnel & Administration. Additionally, the Colorado Department of Labor & Employment is in the process of moving to this model. The success of these efforts beyond the initial target audience across the enterprise show that this innovation could be repurposed by other state governments in an impactful way.

On top of it all, this project fits directly into Governor John W. Hickenlooper's gubernatorial priorities of efficiency, effectiveness and elegance by completely elevating the quality and timeliness of service for Coloradans. There are nearly 1,500 employees who benefited from this project (as it benefited all of the Colorado Department of Revenue's employees). Additionally, the ultimate benefit from this project was for the customers of the Colorado Department of Revenue, which is the entire population of Colorado residents (approximately 5 million people). Coloradans are the users of the essential Colorado Department of Revenue applications affected by this project -- from taxes to DMV to enforcement (gaming, marijuana, liquor, etc.) and more.

c. **Impact**

Thanks to the Infrastructure Modernization initiative, Coloradans now have a reliable system that performs much faster and more efficiently. The new system not only has a reduced footprint, but it has proven to be more reliable with a high performance connectivity.

Residents from all 64 Colorado counties depend on the Colorado State Title and Registration System (CSTARS) for their vehicle titles and registrations, and now the information needed by the Colorado Department of Revenue (DOR) and county staff to service these essential requests is available quicker and with greater accuracy. The more stable and reliable system not only creates creates increased efficiency for those who need the data on the internal agency side, but it also improves service and creates a more seamless experience for our customers.

The impact of this project is immense:

- The Infrastructure Modernization initiative reduced physical footprint across four locations, with more than 200 physical servers decommissioned
- System availability increased from 98.3 percent in 2013 to 99.91 percent as of February 2016; and network availability was increased to 99.97 percent
- Virtual servers perform much faster than the old system -- processes that took 45 minutes now take two minutes, and others that took four hours take 10 minutes
- The systems are now also easier to manage and problems (which don't happen as frequently) are easier to troubleshoot
- Increased bandwidth between DOR facilities and improved performance and connectivity
- New upgraded modernized network hardware to allow virtualization
- Reliable, high performance connectivity between DOR and OIT within DOR systems

- Standardization of the interface between DOR and OIT
- Ability to support DOR applications in OIT data centers
- Separation and segmentation of the DOR infrastructure for security virtualization allows for the consolidation of physical servers at a ratio up to 10:1, decreasing server footprint and allowing for greater flexibility and efficient server management
- New storage for production data and new storage for backup data