

New Jersey Housing & Mortgage Finance Agency Re-Engineering the IT Infrastructure with Virtualization

Management Challenge - With the economic challenges and budget constraints at all levels of the economy, focusing on cost savings and spending reduction, efficiencies, reducing resource usage, eliminating any unneeded assets, “Going Green,” and the like have become vital. As a result, public sector agencies have begun to embrace virtualization within their IT infrastructure – NJ HMFA has accomplished this, along with other infrastructure and network-related advancements.

Innovation in Achieving Strategic Objectives - Virtualization is an innovative technology that enables an organization to create and run multiple virtual machines on a single physical network server. This allows one virtual host to share its physical resources across multiple virtual server environments.

Achieving Agency strategic objectives for affordable home ownership and other housing opportunities for New Jersey residents has become dependent in part upon an effective and efficient IT infrastructure. Daily business processes, communication with constituencies, managing documents and data, information security, and other aspects of work have become operationally reliant upon the IT infrastructure. Accordingly, the Division of IT within NJ HMFA identified and assessed key areas of focus for increased efficiency and performance within the technical infrastructure. We implemented server virtualization and other infrastructure upgrades to meet a number of challenges within the network, data center, IT, and end user environments, achieving benefits as follows:

- Minimized overall operating expenses through virtualization by reducing the number of physical servers through consolidation of servers, also achieving a “greener” operational environment (less power consumption for hardware and cooling).
- Achieved energy and maintenance efficiency in the data center through cable management and improved leverage of newer equipment.
- Eliminated the need to purchase and maintain additional servers for new programs and functions.
- Achieved greater IT infrastructure performance, redundancy, security, and flexibility by re-engineering the network infrastructure.
- Facilitated IT disaster recovery and business continuity efforts through research and deployment of new technology.
- Provided more efficient centralized server and storage management (of data and files) for production and development platforms.
- Enabled IT to duplicate and more rapidly deploy frequently-utilized development platforms.

The effects of server sprawl combined with high energy costs, floor space, server management complexities, the need for rapid provisioning, and lack of full computer resource utilization are all addressed by server virtualization.

Achievements – The IT infrastructure advancements resulting in improvements to network reliability, power consumption, physical organization, equipment utilization, storage utilization, and IT infrastructure management and demands on staff time are:

- *Server Consolidation/Virtualization* - The IT Division engaged in an ambitious virtualization initiative, converting many of our core and ancillary systems to virtual machines. In the process, several older less-efficient systems have been consolidated and decommissioned. This has resulted in considerable power savings as many virtual machines can run on a single physical host. Older equipment is targeted for disaster recovery use. Operational costs such as purchasing additional servers and additional HVAC units, as well as equipment maintenance expenses, have been significantly reduced.

Devices no longer needed or obsolete have been removed from the data center, catalogued, targeted for disaster recovery, or provided to the State Surplus Warehouse for availability

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elsewhere. Servers that have been decommissioned have been physically removed as well as their associated cabling.

- *Storage Management* – Utilizing storage management tools such as File Resource Management Services (FRMS) and disk quotas, we were able to drastically reduce the amount of storage necessary in our environment. In addition to the cost savings, this has many related benefits such as reduced backup times, lower tape consumption, and better management of existing space.
- *Thin Client Devices* - Another enormous impact to energy savings, purchase costs, and maintenance efforts, is that of thin client end user devices. Thin clients utilize server-based computing, Citrix in our case, rather than a full desktop for each user.
- *Core Switch Re-Engineering and Business Continuity* - The configuration of the Agency's core switch infrastructure was analyzed and configuration changes were implemented to achieve a redundant environment with a 2nd core switch. Among these were VTP (vlan trunk protocol) configuration, the use of a hybrid operating system, trunking configuration, and trunk redundancy. Due to time constraints, complexities involved in switching from hybrid to native mode, and other major initiatives, consulting services was retained to assist with the transition.
- *VLAN Segregation* - Several existing but unused VLANs (virtual local area networks) were put into use in order to better isolate and segregate certain types of network traffic. Separate VLANs were used for printing, network management and IP storage. This has had the effect of protecting critical network traffic from the effects of broadcast storms and excessive utilization.
- *Ethernet/Fiber Cabling Management* - The Ethernet and fiber cabling were shortened, re-terminated, re-routed as needed, or in some cases replaced. As fiber cables cannot easily be shortened, additional cable management was installed and several fiber patch cables re-routed. This helped to improve airflow and cooling.

Benefits and Cost Savings - The IT Division's assessment identified that the benefits of server virtualization and storage consolidation are enormous. Licensing for the virtualization platform, as well as a network attached storage (NAS) replacement to an aging storage area network (SAN) were the major costs in this effort. These were more than offset by the many benefits and cost savings that include:

- *Power Savings* - running multiple virtual machines on a single physical host saves a tremendous amount of electricity.
- *Equipment Utilization* - Most normal physical servers utilize only a fraction of their processing and I/O (input/output) capabilities at any given time. Virtualization allows us to take the full advantage of a machine's resources. Additionally, 50 thin client devices have been deployed replacing many older inefficient PCs. The cost of the thin client is 1/3 that of a new workstation, which is equivalent to a 66% cost savings per device.
- *Flexibility* - The ability to run several different operating systems concurrently on the same hardware, or to dynamically allocate CPU (central processing unit) memory and storage resources before and after a machine has been provisioned, as well as the ease of management provided by controlling multiple machines from a single client machine, are benefits possible only through virtualization.
- *Backup and Recovery* - Server virtualization provides the ability to easily take an encapsulated backup of a virtual machine (VM), and to restore and run that same VM on different physical hardware. This is a significant benefit in ensuring smooth operational recoveries when needed and in case of a disaster. A virtualized file system also provides the ability to perform snapshots, a process by which the state of a virtual machine can be frozen and reverted to in the future. Snapshot technology inherent in our chosen storage solution allows for on-demand point-in-time

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backup and recovery of both individual files and complete virtual machines.

- *Provisioning* - Virtual machines and their associated storage can be saved as a template or cloned with far greater ease than with physical equipment. The provisioning (installation, configuration, security, etc.) of a virtualized server can be accomplished in minutes rather than hours. The use of NFS (Network File System protocol) based storage allows for thin provisioning (flexibly allocating disk storage) of virtual machines and greatly reducing the amount of storage required in traditional environments.
- *High Availability* - Having separate virtual environments on a server, as opposed to installing multiple applications on the server, allows administrators to bring down one environment without impact to another if a reboot is needed. If one application hangs, it does not impact anything else.

It is important to note that all of these improvements and accomplishments were completed with little or no consulting services. This provided tremendous cost and time savings to the Agency. Initially, during the evaluation phase, there was no cost in using VMWare's free virtualization product, combined with in-house knowledge and technical expertise, to leverage these improvements.

Effective Use of Resources – One of the greatest benefits of server virtualization is its ability to aggregate system resources of many virtual machines over a few physical machines. Currently, our virtual-to-physical machine ratio averages 10-to-1, that is, 50 virtual machines running on 5 hosts and a single storage appliance. The project has been very successful and has saved a great deal of IT support staff time, in addition to the expected energy savings.

The addition of the vSphere virtualization environment and a new NFS-capable SAN has allowed us to leverage our existing equipment even further. This innovative implementation freed up hardware to use for disaster recovery in an off-site location. We have achieved significant cost savings in terms of physical space needed, reduction of hardware maintenance costs on older equipment, and reduction of electricity consumption to power and cool operational equipment.

Measurable Improvements in Agency Operations - Server virtualization has resulted in a dramatic decrease in the amount of cooling and power consumption in our data center due to the displaced physical machines. With regard to servers, in some cases we are running 10-12 virtual machines on a single physical host server. Removal of obsolete equipment maximized rack space and increased air flow. With regard to thin clients, a typical PC can draw up to 250W of electricity, whereas a thin client draws about 17W. With the implementation of the thin clients, power consumption is reduced, less heat is generated, and the purchase cost was approximately 1/3 the cost of a workstation. To date, 50 thin client devices have replaced older, less-efficient workstations.

Development, testing, and implementation of business systems has been accelerated, as it is now much simpler to deploy multiple technical environments for use in the system development life cycle, benefiting both IT staff and the end user community. Recovering systems for operations and retrieving "lost" files for users via snapshot technology is another improvement.

Replicable - A management focus on the IT infrastructure, particularly the network and data center, and on the level and variety of needed technical experience and skills is key. Virtualization, as well as the other upgrades, can be implemented by other Agencies in-house through existing skills if present, training, consulting services, and/or technical staffing. Modern virtualization solutions are extremely scalable, and agencies of any size can enjoy their benefits. Even smaller shops with only a few servers can experience similar benefits with solutions sized to match the environment. An organization can start realizing the benefits with a single host in the smallest of lab environments. As an added incentive, most entry-level virtualization solutions are offered at no cost. The benefits of virtualization far outweigh the cost involved, as well as supporting a greener environment.