System and Storage Virtualization
For iOS (AS/400) Environment

How to take advantage of today’s cost-saving technologies for legacy applications

Date: March 10, 2011

Copyright © 2010 INFINITE Corporation. IBM Midrange, AS/400, OS/400 and System/36 are registered trademarks of the IBM Corporation. Windows, Internet Explorer, Visual Basic, VB Scripting are registered trademarks of Microsoft Corporation. Java and Sun are registered trademarks of Oracle Corporation. INFINITEnet, INFINITE/iSeries and INFINITE36 are registered trademarks of Infinite Corporation. All other product and brand names are registered trademarks of their respective companies. No part of this document may be reproduced without written permission of INFINITE Corporation.
TABLE OF CONTENTS

Virtualization for the iOS (AS/400) environment 3
Introduction 3
Server virtualization total cost of ownership 3
Cost considerations 3
Virtualization within the native environment 3
How to achieve virtualization for AS/400-based applications 4
Conclusion 6
Virtualization for the iOS (AS/400) environment

Introduction
Consolidation through server and storage virtualization is a powerful agent for datacenter change, but shrinking your server footprint is just a part of the value that server virtualization brings to your IT organization. This paper explores the TCO of server virtualization, the costs that drive TCO and factors you should consider when calculating the return on your next virtualization investment.

Server virtualization total cost of ownership
It is no surprise that server virtualization lies at the heart of most cost-cutting initiatives in today’s datacenters. With server consolidation ratios commonly in double digits, organizations are able to reduce their existing server presence to a fraction of their current footprint. Organizations see an immediate drop in datacenter space, power and cooling requirements. Budgets previously allocated to keeping the lights on in the datacenter can be repurposed for IT projects that will improve operational efficiency and service level delivery. Consolidation through server virtualization is a powerful agent for datacenter change, but shrinking your server footprint is just a part of the value that server virtualization brings to your IT organization.

While IBM has provided LPAR tools for the AS/400 environment, they have not addressed the need to use industry standard virtualization tools to reduce costs for RPG or COBOL/400 applications. This paper explores the Total Cost of Ownership (TCO) of server virtualization for the AS/400, the costs that drive TCO and factors you should consider when calculating the return on your next virtualization investment. It also explores the softer benefits of server virtualization that extend beyond basic consolidation and how advanced virtualization management included with Red Hat using Red Hat Enterprise Virtualization can help you derive even more value from your existing IT environment.

Cost considerations
IT costs are driven by a combination of easy-to-calculate factors such as server, storage and networking gear to more difficult to identify expenses such as the cost of downtime, environmental impact and productivity. TCO can be misrepresented by free online tools or miscalculated through inaccurate assumptions and overcomplicated calculations.

When calculating TCO, we recommend simplifying the number of inputs, assumptions and calculations to a manageable set of real-world factors that apply to almost all IT organizations: servers including operating system costs, storage, space, power and cooling and specific requirements like HA and DR. We also recommend adding the cost of downtime and service level delivery, implementation services and environmental factors, and IT administration. These are typically calculated by adding the direct and indirect IT costs for the useful life of a project or technology. In this case we use three years as the useful life with the understanding that IT organizations will see benefits beyond three years.

You will want to compare the total cost of acquiring and maintaining a complete computing environment: new servers, networking and storage hardware, IT administration, software, datacenter space, power and cooling. Server consolidation is the primary driver for most virtualization projects.

Virtualization within the native environment
Logical partitioning is performed on the hardware layer. CPUs may be dedicated to a single LPAR, or shared. Two LPARs may access memory from a common memory chip, provided that the ranges of
addresses directly accessible to each do not overlap. One partition may indirectly control memory of a second partition, but only by commanding a process of the second partition to directly operate on the memory. Virtualization allows you to have multiple "virtual machines," each with its own operating systems running, shielded from each other, all in one physical machine. Each virtual machine shares a common set of hardware, unaware that it is also being used by another virtual machine at the same time.

Within the native AS/400 environment, hardware and iOS operating system costs are very high, as are storage, space, power, cooling and i OS-specific utility software.

The AS/400 cannot use virtualization tools to maximize server utilization nor can it use virtualization tools for storage. The HA/DR plan is expensive and requires iOS proprietary software. There is no storage virtualization plan and the current utilization is not efficient. Infinite allows you to take advantage of these technologies

**How to achieve virtualization for AS/400-based applications**

While existing servers can be used for new server virtualization deployments, we recommend replacing older AS/400 equipment with newer, faster, more efficient servers like Dell or X series Blades. You can take advantage of these low cost virtualization technologies by rehosting AS/400 applications to open operating software and platforms that support them by utilizing tools like Infinite iSeries (http://www.infinitecorporation.com/solutions/InfiniteiSeries.asp). Recompile the source for the new environment using the developer environment and redeploy it on Red Hat Linux running Red Hat Enterprise Virtualization

The new servers that will run the virtualized workloads are 2U blade servers, each with 2 CPU, quad-core processors equipped with a total of 16 GB of memory each. Networked storage is a must-have for organizations that want to take advantage of the most compelling features of virtualization, such as live motion, high availability, provisioning templates and other high value features.

For many organizations, the migration to virtualized infrastructure leads to a costly and complex storage architecture upgrade. Fortunately, RHEV has multiple choices for storage networking architecture that include fiber channel (FC) SANs, iSCSI SANs or NAS architectures. A significant issue is how to best take advantage of the powerful storage reduction technologies included in the latest storage offerings. Thin provisioning, snapshots and data deduplication technologies are among a number of space saving storage technologies that can turn an otherwise costly storage upgrade into an opportunity for storage savings. In this example we assume a storage reduction factor of 50 percent as is typical with the latest space saving technologies in advanced storage arrays.

Capacity planning and consolidation ratios vary widely depending on workload demands, server capacity and virtualization software. We recommend using a capacity planning tool for determining actual server requirements. However, some general guidelines will prove helpful in calculating TCO for server virtualization VMs per processor core. For TCO calculations, use the following estimates as rule-of-thumb projections.

- For light workloads, such as virtual desktops, use 4-8 VMs per processor core as the basis for your calculations.

- Use 2-4 VMs per core for medium workloads.
- For demanding workloads use 1 or fewer VMs per processor core.

RHEV includes advanced storage integration to allow organizations to take full advantage of storage reduction technologies and performance optimizations included natively in storage arrays. By plugging directly into storage vendors’ array capabilities, RHEV allows organizations to reduce their overall storage footprint and increase storage flexibility associated with provisioning, copying and protecting virtualized infrastructure and data.

One thing you should consider is that while the total number of physical servers is dramatically reduced, the workload density relative to physical infrastructure increases dramatically. Consequently the activity and number of configurable network parameters, including the overall number of IP, may in fact increase the stress on your network infrastructure. VM sprawl can compound this problem if not managed properly. As a result, we recommend that you properly plan for expected network activity and targeted consolidation ratios in order to determine whether you need a significant upgrade network gear to handle higher loads. Overall networking costs are fairly straightforward to calculate in a virtual environment. The safest way to estimate VM memory requirements is to simply add the total amount of memory each application would require in a physical environment. It is not uncommon for virtualized servers to require as little as 512 MB per VM on the low end or as much as 4 GB per VM on the upper end. However, do not assume that existing physical allocations are accurate. Many organizations routinely over-provision memory by a factor of two to three times.

Additionally, we recommend taking advantage of the latest advances in power saving technologies included in next generation server hardware from Dell or IBM. Despite rapid advances in technology in past years, most servers still consume about 80 percent as much power while running at low utilization levels as they do when the systems are fully taxed. Likewise, power consumption resulting from datacenter cooling demands may approach that of the power consumption of operating the servers, nearly doubling the total energy draw on a per server basis. Consequently, a 10:1 consolidation ratio would result in energy costs savings of as much as 85 percent, even when considering that pre-consolidation servers run at lower capacity.

Additional savings can be achieved with more recent advances in power management, including a new generation of energy-efficient processors from both Intel and AMD. For this reason, we recommend investing in new server technologies when you migrate from existing physical to virtualized infrastructure.

We recommend including datacenter space in TCO calculations, even if you are not on the brink of running out of room in your datacenter. By consolidating today, you can avoid unnecessary expansion tomorrow. On average, datacenter space can be rented for between $100-200 per square foot annually. However, when total datacenter build-out costs are considered, along with the cost to maintain facilities, the annual cost per square foot will likely be three to four times the cost of raw space. Another consideration is rack server density. Here we assume 15 2U servers in a 42U cabinet space since space, power and cabling prevent fully loading the server cabinets.

RHEV is a complete virtualization solution that combines unmatched performance and scalability with advanced virtualization management to give organizations the tools necessary to streamline the delivery of datacenter applications. RHEV is priced per physical server, regardless of the number of CPU sockets or cores on the system. When considering software, support and maintenance costs, RHEV is about one-third the total cost of competing virtualization solutions on 2 CPU servers. This includes HA protection for
management servers that other vendors charge separately for and which is very expensive in the AS/400 marketplace.

There are other important factors to consider. In particular, advanced storage integration, dynamic provisioning services, workload balancing and high availability, among other advanced features, contribute to business continuity, infrastructure and operational efficiencies that shrink TCO even further. An example of savings afforded by RHEV is the operational savings achieved through dynamic provisioning of server workloads. Dynamic provisioning services included with RHEV allow organizations to provision new server workloads on demand as need arises. Organizations can go from a bare-metal to a fully booted and provisioned server in seconds, and re-provision, update or roll back their servers just as quickly. Provisioning activities for a single workload can be reduced from a full day or more to just a few minutes. Provisioning efficiencies alone can free up valuable time of a very over-burdened group of IT administrators.

Other operational savings involve eliminating the complexity of manual storage operations associated with the creation of new workloads. Storage provisioning can easily total more than 30 manual steps for a single LUN, not to mention cumbersome interaction between storage and server administrative teams.

RHEV also includes a number of every day tools such as virtual machine templates, live migration, virtual networking tools and resource pools that allow the sharing of configurations and settings across physical and virtual servers. While administrative efficiencies will vary widely according to the applications being virtualized, it is not uncommon for administrators to be able to manage three times the number of workloads when using RHEV instead of i OS. This allows IT managers to free up administrators to initiate projects that will help transition IT into a more dynamic delivery center. Managed correctly however, virtualization can be a powerful tool in quickly delivering the applications and workloads to consumers of IT resources. It allows administrators to automate the setup and tear-down of complex application workload configurations, provide self-service template libraries to developers for rapid provisioning, reduce VM sprawl and enable cross-team collaboration on common virtual environments.

**Conclusion**

Low TCO leads to positive ROI using RHEV, organizations can cut the cost of delivering IT by nearly two-thirds through efficient use of datacenter infrastructure and streamlined administration. Such a low TCO translates into an overwhelmingly positive ROI. If you are calculating ROI, you should consider all incremental capital outlays for delivering virtualized infrastructure, not just virtualization software as some online ROI tools portray. Simplistically, ROI involves totaling the benefits of virtualization (i.e., cost-avoidance) then dividing by the virtualization investment. Remember, your virtualization investment is more than just the cost of new software license. If you consider the cost of new servers, storage, networking and software as your investment and IT cost-avoidance (i.e. the TCO differential between virtualized and non-virtualized) as your return, then this scenario would yield a 400 percent return on investment over a three year period. Through its stage management tools, RHEV streamlines the process of building, testing, sharing and delivering applications into production environments. Administrators can create customizable and automated workflows that encapsulate multi-machine service configurations and move them through pre-production staging and integration testing processes, improving quality and minimizing the time to deploy critical updates or new business services.

Authored by Bruce Acacio, Carol Conway and Lisandro Olmedo
Infinite Corporation, Mission Viejo CA USA