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About Infosys

Infosys Technologies Ltd. (NASDAQ: INFY) defines, designs and delivers IT-enabled business solutions that help Global 2000 companies win in a flat world. These solutions focus on providing strategic differentiation and operational superiority to clients. Infosys creates these solutions for its clients by leveraging its domain and business expertise along with a complete range of services.

With Infosys, clients are assured of a transparent business partner, world-class processes, speed of execution and the power to stretch their IT budget by leveraging the Global Delivery Model that Infosys pioneered.

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Content

Preface

From the Editors’ Desk

**Perspectives on IT Optimization**

1. Shed Light on your ‘RTS’: Driving Optimization through Financial Transparency 05
2. Outsourcing Trends in IT Optimization: A Survey-based Article 13
3. IT Optimization: Roadmap to Cost Reduction 19
4. IT Optimization Driven by Information Lifecycle Management (ILM) Program: A Case Study 31
5. Post-Merger Optimization: Defining a Roadmap to Success 43

**IT Optimization Models and Techniques**

6. IT Optimization on the Cutting Edge: Opportunities via Joint IP Creation and Divestment of IP Assets 49
7. Tapping into SaaS and Pre-packaged Models to Drive Optimization 57
8. Virtualization: A Cornerstone of Infrastructure Optimization 67
9. UoW Model: Optimization through Innovative Pricing 77
10. Effective IT Optimization by Process Optimization 85
Virtualization: A Cornerstone of Infrastructure Optimization

Immense efficiency can be derived from reconfiguring and consolidating an Information Technology (IT) organization’s infrastructure. Simplified and streamlined servers, storage, and even desktops can slash operating expenses, increase productivity, and reduce an organization's carbon footprint. Virtualization is the key to entering the hardware optimization castle, and is rapidly becoming one of the hottest optimization trends in the IT industry. This article breaks down what you need to know about virtualization, why it should be implemented, and how it can be done - kick-starting your infrastructure optimization journey.

Introduction

As organizations push through one of the more difficult financial and business situations of their times, CIOs are under tremendous pressure to find new and innovative ways to reduce costs and improve productivity. Furthermore, in a distinct shift from past behavior, organizations are looking to optimize the existing IT environment and achieve more efficiency, rather than adding to the overall IT footprint. The buzz phrase of 2009-2010 is “get more, for less” - something easier said than done, for there are many challenges to overcome and risks to manage.

Effective optimization is made possible by choosing the right mix of business and technology initiatives. When implemented intelligently, technology can be an especially powerful optimization tool. A consolidated and optimized IT infrastructure results in cost reduction and improved business performance. Technology-led transformation and modernization initiatives - such as Consolidation and Virtualization, Green IT, and Legacy Modernization - can be used as a driving force to help banks achieve IT Optimization.

The IT Landscape is currently undergoing a transformation. IT is moving away from the traditional “support model” to a “service model” aligned with the business. Figure 1 highlights some key components of the shift.
Virtualization has come to be recognized as a cornerstone of the transformation journey of any organization, playing a very vital part in the ongoing efforts of optimization. Virtualization helps organizations to reduce cost - cutting down on the physical space requirements, power, cooling, and also the cost of managing and maintaining the environment.

### Approaches to Virtualization

**Strategic**
- Cost Reduction
- Increase Operational Efficiency
- IT Optimization (Infra + Apps)
- Technology alignment with business needs
- Real Estate Optimization
- New Technology Adoption

**Tactical**
- Power Saving Initiatives (move to blades)
- Network Consolidation
- Server & Application Rationalization
- Server / Storage HW Upgrades / Refresh

**Drivers**
- Server & Storage Virtualization
- Application Migration & Re-engineering
- Datacenter Consolidation
- Cloud Computing

**Thrust Areas**

<table>
<thead>
<tr>
<th>Today’s Infrastructure</th>
<th>Tomorrow’s Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designed to Last</td>
<td>Designed to Change</td>
</tr>
<tr>
<td>Manage Physical Resources</td>
<td>Will Manage Virtual Resources</td>
</tr>
<tr>
<td>Underutilized and Over Provisioned Hardware</td>
<td>+ Time Shared and Pooled + Real-time Workload Management</td>
</tr>
<tr>
<td>Long &amp; Complex Deployment Cycles</td>
<td>Short &amp; Easier Deployment Cycles</td>
</tr>
<tr>
<td>Focus is on Cost</td>
<td>Focus is on Business Value Management</td>
</tr>
<tr>
<td>Energy Expensive</td>
<td>Energy Efficient</td>
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</tbody>
</table>

**Figure 1**

**Tomorrow’s Infrastructure**
- Designed to Change
- Will Manage Virtual Resources
- + Time Shared and Pooled
- + Real-time Workload Management
- Short & Easier Deployment Cycles
- Focus is on Business Value Management
- Energy Efficient

**Today’s Infrastructure**
- Designed to Last
- Manage Physical Resources
- Underutilized and Over Provisioned Hardware
- Long & Complex Deployment Cycles
- Focus is on Cost
- Energy Expensive

68
Virtualization Vision

Virtualization should be viewed with a long term strategy and vision. It is only in the longer term that virtualization will be able to deliver desired results, though it can help achieve certain strategic goals/quick wins in the short term. The vision of virtualizing infrastructure components should also align with the business objectives, statutory and regulatory compliance, and should be part of the IT roadmap, rather than standing alone.

Virtualization today has come to engulf almost every component in the IT Infrastructure and application footprint. Servers, Operating Systems, Storage Devices, Data, Network Devices, and even desktops and laptops can be virtualized to provide a more efficient and Green IT Environment (see Figure 2).

Virtualization is not a standalone technology. It is an enabler for many other strategic initiatives. It is not an end, but rather a means to achieve more technological advances like Cloud Computing and Green IT.

Virtualization has become the foundation of Cloud Computing, which is another emerging technology trend. Cloud leverages all the capabilities of a virtual environment, and virtualization is employed at all levels - Servers, Storage, Data, etc. Private Clouds are also becoming increasingly popular within banking institutions moving from a support model to a service model.

Server Virtualization

Virtualization allows a set of physical servers to be shared and partitioned in such a way that multiple, logical server instances are created. The instance is complete in itself, and includes the operating system and hardware resources of a non-virtualized server. The end-result is a virtual server that can be used for hosting applications and services.

Server Virtualization results in “secure slices” of operating systems hosted on virtual machines, without compromising on any of the critical performance parameters like security, availability, and scalability. The beauty of virtualization is that it can support dynamic provisioning of resources to the required applications, “on-demand”. Simply put, virtualization allows you to slice and dice one big computer into smaller computers.

Though virtualization as a concept is not new and has been in existence since the late 1970s, technology solutions today are available for virtualizing all flavors of server operating systems. While UNIX and Linux come with their own Virtualization capabilities, there are also other hosted virtualization applications like VMware and Hyper-V that help in creating and managing virtual servers. Also, these technologies have certain migration tools that will aid in migrating from physical/virtual to a virtual environment.

<table>
<thead>
<tr>
<th>Drivers for Virtualization</th>
<th>Figure 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contain “Server Sprawls”</td>
<td>Lower Maintenance Costs</td>
</tr>
<tr>
<td>Reduce power, cooling requirements</td>
<td>Reduce physical footprint</td>
</tr>
<tr>
<td>Improve hardware utilization</td>
<td>Isolate applications from each other</td>
</tr>
<tr>
<td>Quick Scalability</td>
<td>Reduce Management overheads</td>
</tr>
</tbody>
</table>
In addition to moving the physical server and the Operating System (OS), the application also needs to be migrated to the new virtual machines. Unfortunately, it is very likely that a few of the applications might not work in a virtual environment. Especially in a banking environment, where there are high chances of legacy applications and applications on older technologies (e.g., FoxPro or COBOL) being present, it is advised that proper testing be done to validate the working of such applications in a Virtual environment, before migration.

Virtualization contributes to Green IT. Reduction in power usage, cooling, and reduced carbon emissions add up to the Green Quotient of the organization. Of late, Blade Infrastructure has become an essential part of the IT infrastructure of any bank. In contrast with the big legacy boxes seen in banks and other financial institutions, blade servers provide an excellent platform to reduce the carbon footprint. Technology today supports hosting virtual machines on Blade servers, and even performs clustering between as little as two blade servers.

**Benefits of Server Virtualization**

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Figure 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction in Server Footprint - A virtualization ratio of ~12:1 for production and ~16:1 for Non-production environments can be achieved</td>
<td></td>
</tr>
<tr>
<td>An average savings of around 16-23% in Opex can be achieved</td>
<td></td>
</tr>
<tr>
<td>8-14% productivity increase can be achieved by use of proper tools to manage and migrate the Virtual Environment</td>
<td></td>
</tr>
<tr>
<td>Infrastructure consolidation and standardization would reduce support calls by 6-8% in the first year and 14-17% YoY for the subsequent years</td>
<td></td>
</tr>
<tr>
<td>Virtualization increases agility and scalability - provides “on-demand” resource allocation</td>
<td></td>
</tr>
</tbody>
</table>

# Based on Infosys research and past experience
# Data shown is indicative and will vary based on size & complexity of the environment

Storage Virtualization

Storage virtualization refers to the process of abstracting logical storage from physical storage. Virtualization of storage helps achieve location independence by abstracting the physical location of the data. The virtualization system presents, to the user, a logical space for data storage and handles the process of mapping it to the actual physical location.

Storage virtualization adds a new layer of software and/or hardware between storage systems and servers, so that applications no longer need to know on which specific drives, partitions, or storage subsystems their data resides. Availability also increases with storage virtualization, since applications aren’t restricted to specific storage resources, and are thus insulated from most interruptions.

Figure 5 describes three major ways of implementing Storage Virtualization.

Typically, banks and other financial institutions have multiple storage devices implemented - Storage Area Networks (SAN), Network Attached Storage (NAS), Direct-Attached Storage (DAS), etc. - and the average utilization levels are around 40-55%.
Hence, it is more economical to virtualize and consolidate storage devices rather than make new purchases. It is advisable to consolidate all mission critical databases and applications into SAN and all file storage into NAS. Technology today supports virtualization of both SAN and NAS devices, facilitating seamless data storage across the organization.

**Implementation of Storage Virtualization**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Key Advantages / Disadvantages</th>
</tr>
</thead>
</table>
| Host          | • Agent software on each host  
• Support In-band and Out of band modes  
• Device driver intercepts IO requests, looks up metadata, and redirects IO | • Since this is agent based, the performance will be lower  
• Increased license cost |
| Network       | • Appliance based implementation  
• Defines IO transfer path and supports multipathing  
• Appliance-based implementation | • High availability, by having redundancy in ports and controllers  
• Intelligent failovers  
• Independent of the physical hosts |
| Storage Device| • Virtualization capability, built into the disks and controllers (of the SAN Device)  
• Supports virtual arrays and disks  
• Virtual Tape Library (VTL) | • Usually the capex is high, though opex will reduce |

**Desktop & Application Virtualization**

Desktops and applications can also be virtualized. However, this doesn't mean that desktops or laptops will give way to an LCD panel with jazzy images on it controlled by a remote device. Instead, virtualization helps to ensure that the end-user computing is very light and thin. Thin clients can be used to replace heavy desktops and laptops.

**Benefits of Storage Virtualization**

<table>
<thead>
<tr>
<th>Benefits of Storage Virtualization</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Improves device utilization levels</td>
<td></td>
</tr>
<tr>
<td>Reduces storage management complexity and overall costs (by at least 9% per Petabyte)</td>
<td></td>
</tr>
<tr>
<td>Facilitates interoperability and more “open” storage systems</td>
<td></td>
</tr>
<tr>
<td>Storage virtualization reduces complexity, by resource pooling</td>
<td></td>
</tr>
<tr>
<td>Fewer points of management</td>
<td></td>
</tr>
<tr>
<td>Non-disruptive data migration</td>
<td></td>
</tr>
<tr>
<td>Storage consolidation can save organizations nearly 40% in acquisition costs and over $45,000 in power and cooling expenses over a three-year period</td>
<td></td>
</tr>
</tbody>
</table>

*Data shown is indicative and will vary based on size & complexity of the environment*
and still provide users access to the same set of applications and computer settings.

With roots in the thin client models of yesteryear (e.g., Citrix), desktop virtualization is not a new concept. Nevertheless, application virtualization and the streaming of applications to desktops from a central location is new technology that will help to reduce costs and increase efficiency and scalability.

Desktop virtualization or Virtual Desktop Infrastructure (VDI) is also one of the key elements in the application virtualization infrastructure. VDI is used as a medium to stream applications to the end-user community. Application virtualization helps to reduce the complexity around OS compatibility and to deliver applications on demand. This also helps to streamline the license count within the enterprise.

How do VDI and Application Virtualization help banks?

- In a retail bank, all users might not need or use a particular application (e.g., MS Office). Instead of being installed in the local desktops and not being used (as it will still count as a used licensed), the application (on a need basis) can be streamed from a central location. This is policy driven, and hence can be controlled from a central location.

- Thin clients, which consume much lower power, can replace traditional desktops and laptops. This results in a massive power savings. A thin client with a 19” LCD monitor powered on an average of 12 hours a day consumes around 90 watts, while a PC consumes around 170 watts, which is almost double!!

- PC refresh cycles increase significantly. With thin clients and VDI, the refresh cycle could become anywhere between 5-6 years (or even more) compared to 3 years for a traditional PC.

Though VDI and Application Virtualization involve a heavy upfront investment to create the backend infrastructure, it is an excellent area to reduce cost and provide a secure, reliable, and scalable workplace environment to the end users.

**Key Virtualization Challenges**

- Migrating from a distributed to a consolidated environment

<table>
<thead>
<tr>
<th>Benefits of Desktop &amp; Application Virtualization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Desktops use less than one twentieth of the materials required for a traditional PC, resulting in far less e-waste</td>
</tr>
<tr>
<td>Instant provisioning of new desktops</td>
</tr>
<tr>
<td>Significant reduction in the cost of new application deployment</td>
</tr>
<tr>
<td>Anywhere access to the Virtual PCs (even from a Internet browsing parlor)</td>
</tr>
<tr>
<td>Allows applications to run in environments that do not suit the native application</td>
</tr>
<tr>
<td>Improved security, by isolating applications from the operating system</td>
</tr>
<tr>
<td>Run incompatible applications side-by-side, at the same time and with minimal regression testing against one another.</td>
</tr>
</tbody>
</table>
• Multiple versions to be consolidated – Managing Version inconsistencies

• Manage performance issues and overheads

• Application Compatibility with Virtual Servers and OS

• Aligning the management to the Infrastructure with Virtualization

• Adoption of Virtualization within the IT Organization is a main challenge as it involves additional skills

• Selection of the Virtualization solution is, by itself, a bigger challenge

• Rollback in case of any failed migration is a project by itself!

Best Practices

• Start by Virtualizing the Test / QA environments (non-critical environments)

• Adopt “Basic Virtualization” to begin with (x86 architectures)

• Implement “Advanced Virtualization” (RISC, HPC Architectures) once stabilized

• Implement VM Management and Monitoring systems during Virtualization

• Review the security, IT service delivery policies in light of virtualization

When to avoid Virtualization

Though virtualization provides a host of benefits, it also comes with its own share of concerns and disadvantages. It is prudent to avoid virtualizing resources under certain circumstances. These include:

• Migrating applications that do not support virtualization

• Highly resource intensive and proprietary applications

• Those applications which makes heavy system calls

• Large Databases

Virtualization Roadmap

Adopting virtualization is both easy and tough. Easy, in the sense that the initial virtualization exercise can be carried out with the existing hardware (and, of course, with a little bit of change). Tough, in the sense that it is time consuming, involves heavy capital investment upfront, and also needs skill enhancement for the administrators and the support team to manage and maintain the virtual environments.

It is recommended that as a first step of any virtualization exercise a proper assessment and analysis should be done, a roadmap created, and a strategy defined. This is very critical to put the exercise on a path to success. Illustrated in Figure 8 is an indicative technology roadmap for adopting virtualization in banks.

Additionally, as an illustration of how the IT Optimization initiatives are aligned with the business requirements, Figure 9 represents a typical project blue sheet. This would be used to help the IT organization map the requirements to the initiatives.

Conclusion

Virtualization is a key strategy that organizations can and should adopt as part of their IT optimization journey. With varying needs - controlling the sprawling Infrastructure spread, increasing demand for compute power, and improving the speed at which the businesses expect the demand to be met - it is natural for an enterprise to look at implementing a mature solution. That is exactly what virtualization aims to provide.

Change is inevitable. And virtualization is here to stay. Whatever be the size of the Infrastructure footprint, there is a compelling business case for adopting virtualization. Apart from the assured cost savings,
virtualization also brings qualitative changes to the way IT is run. Performance, security, availability, scalability - nothing is compromised, everything is focused to deliver more business value.

References


<table>
<thead>
<tr>
<th>Customer Solution</th>
<th>IT Capability</th>
<th>Priority of Capability</th>
<th>IT Project</th>
<th>Objectives</th>
<th>Business Project</th>
<th>Business Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Datacenter Consolidation (Physical)</td>
<td>Consolidation of Physical equipment and optimization of real estate, cooling, and power</td>
<td>HIGH</td>
<td>Datacenter Relocation</td>
<td>Consolidate multiple Dcs and improve the IT infrastructure in the Dcs</td>
<td>IT Cost reduction initiative</td>
<td>Reduce the overall IT spend</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>IT integration</td>
<td>Infrastructure integration</td>
<td>IT optimization</td>
<td>Seamlessly integrate the IT</td>
</tr>
<tr>
<td>Server Consolidation and Virtualization</td>
<td>Consolidation and virtualization of the Physical servers and storage</td>
<td>HIGH</td>
<td>Server &amp; storage consolidation</td>
<td>Reduce the overall server footprint to improve manageability and efficiency</td>
<td>IT cost reduction initiative</td>
<td>Reduce the opex spend on DC infrastructure - by at least 12%</td>
</tr>
<tr>
<td>Management Infrastructure</td>
<td>Centralized management of the (Server) infrastructure</td>
<td>MEDIUM</td>
<td>Implementation of system center</td>
<td>Provide centralized management capabilities, easy deployment of software and upgrades, cross platform monitoring (Windows, VmWare, Linux etc)</td>
<td>Technology modernization</td>
<td>Improve the agility of the infrastructure thereby helping to improve the end-user and business productivity</td>
</tr>
</tbody>
</table>
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