Getting There:
Developing Your Virtualization Strategy and Deployment Plan

GlassHouse Whitepaper

The benefits of server virtualization have been extolled for quite some time. Over the past year, the success stories have been piling up. It's time to make virtualization and its associated auto-provisioning technologies a strategic component of your infrastructure.

Server virtualization might just be the best opportunity IT executives have to minimize the costs of building and managing their IT infrastructure. The benefits of virtualization have been extolled for quite some time, and over the past year many organizations have been using virtualization for:

- Enabling rapid recovery
- Containment of runaway server growth
- Rapid provisioning
- Hardware consolidation and containment
- Creating development and test environments
- Upgrading hardware
- Utilizing many-to-one server clusters
- Maximizing server resources

Initially tagged as a mechanism for server consolidation, server virtualization has proved to have a positive impact on practically any IT initiative. Whether you are in the process of deploying a new ERM application, deploying or changing infrastructure to help ensure SOX compliance, finally completing your migration from NT to 2003 Server, or doing some combination of the above, now is the time to include virtualization as part of your approach.

Many organizations have initially begun with a grassroots deployment for test environments. As word of the benefits and capabilities of server virtualization has spread, many of our clients are now looking at ways to incorporate a virtualization solution into their computing infrastructure.

Positive first impressions are crucial during the initial introduction of a technology or solution into an organization. Therefore, having a strategy that clearly articulates the business objectives, critical success factors and the expected return on investment, that provides a comprehensive understanding of the costs as well as the real constraints and risks, and that achieves consensus from your organization's key stakeholders, is critical for the success of a virtualization strategy—a strategy that will form the building blocks of your IT infrastructure.

This paper outlines the process that GlassHouse uses with our clients in developing a "virtualization strategy," and how we further assist them in developing a plan to "get there."

Developing the Strategy

Identify and Involve Key Stakeholders

The key to developing a strategy that can be successfully implemented is bringing the right people together at the beginning of the effort and building consensus. Starting with a project sponsor—typically, the person in the organization that controls the purse strings—key stakeholders must be identified and involved. The key stakeholders should include (but not be limited to):

- Project sponsor (CIO, VP Infrastructure, IT Director)
- Key application owners
- Server architecture lead
- LAN/WAN architecture leads
- Data center manager

The sluggish communication and lengthy feedback times inherent in many organizations' traditional deployment processes can make the journey from concept to completion a long and difficult one.

Facilitated sessions can be used to compress the time required to build consensus. This eliminates the painful iterative cycle of repeated meetings with stakeholders. A focused facilitated session brings the right people (the decision makers, the key stakeholders, and the people that are tasked with making it happen) together in a room for a few days to talk it out. Right from the start, the entire team is working from a shared set of objectives. Everyone hears what the rest of the group has to say—putting requirements out on the table, building an understanding of the impacts, developing and rationalizing alternatives and ultimately building consensus. In a facilitated session, there is no delay between question and answer, no telephone or email tag, and no "let's run it by the WAN group." Why? Because a decision maker from the WAN group is sitting at the table.

Participants' involvement in the process not only offers them a vested interest in the final product, but also gives them ownership and responsibility for the solution. This results in people working to clear obstacles instead of perpetuating roadblocks.

Establishing the Business Objectives

The next important step is to establish the shared business objectives that the virtualization strategy will accomplish. As the strategy is developed, continual "testing" against the objectives will keep you on track. These objectives may include:

- Containment of server costs
- Containment of existing servers
- Reducing costs to manage
- Achieving rapid recovery
- Enabling high availability
- Providing instant server provisioning
- Managing growth

Identifying Critical Success Factors

Identifying critical success factors (CSFs) will help to ensure that the strategy will meet the expectations of the technical and management stakeholders. What is a critical success factor? It helps to think of it like this: "What must be true for this effort to be a success?" Examples of CSFs for your virtualization strategy will likely include:

- ROI will be realized within 1 year
- TCO will be reduced by n%.
- Minimum of n% reduction in the time to deploy new servers.
- Reduced server recoverability time by n%.

Identifying Potential Constraints and Risks

Identifying potential constraints and risks early on will help you do one of two things: work to eliminate the constraints and mitigate the risks, or find ways to work with them (or around them) so they don't become significant roadblocks. Identifying potential constraints and risks early on will also make stakeholders feel more comfortable knowing that these kinds of things were considered and will be dealt with.
Typical constraints might include:

- Minimal capital budget to absorb one-time costs
- Limited staff capacity for new initiatives
- Staff uncertainty about a new technology.

Typical risks could include:

- Lack of subject matter expertise on staff
- Potential impact on production servers during a re-provisioning cycle
- Too many services on a single hardware platform
- Lack of thorough understanding of the environment.

Capturing the Assumptions

Capture assumptions as people bring them up. Typically, assumptions are those less-than-obvious things that—when captured—help keep everyone on the same page. Typical assumptions might include:

- All production servers are candidates for the service.
- This service is preferred over stand-alone servers.
- Consensus among the team will be achieved prior to management recommendation.
- Production guests and non-prod guests will all reside on the same hosts (or vice versa)

Developing and Weighing Selection Criteria

Articulate selection criteria that can be used to compare alternatives. This exercise has proven to be a valuable tool to assist in rationalizing multiple (and sometimes competing) alternatives or approaches. The following criteria may be considered:

- Availability
- Reliability
- Manageability
- Recoverability
- Flexibility
- Scalability
- One-time cost
- Performance
- Time to deploy
- Ease of use.

The following table shows how this works. In the table, each of the selection criteria are weighted on a scale of 1-5 based on their relative importance to each other. As strategy alternatives are developed, each alternative can be scored on a scale of 1 to 3 based on the alternative's ability to satisfy a particular criterion. Each score is then multiplied by its corresponding weight. These products are totaled to determine each alternative's overall score.

Criteria	Weight	Alternative 1 Score	Alternative 2 Score
Flexibility	4	3	3
Scalability	4	2	3
Ongoing Costs	3	3	2
One-time Costs	3	3	2
Manageability	4	3	3
Usability	5	3	3
Availability	5	3	3
Recoverability	4	2	3
Conversion Risk	3	2	3
Time-to-Deploy	2	1	3
Functionality	5	3	3
Security	3	2	3
Network Impact	3	2	3
Totals		127	144

Reviewing the Current State

The next step is to review of the current state of your infrastructure and the processes you employ to manage your environment. Some of the most common aspects of your current IT infrastructure to review are:

- WAN design
- LAN design
- SAN configuration
- Intel server architectures
- Server configuration management
- Server provisioning process
- High-level disaster recovery plan overview
- Server profile matrix
- Server license agreements.

Developing a Server Profile Matrix

In developing the architecture, a substantial amount of information is required with regard to the server infrastructure within your organization. The server profile matrix is a tool to help the staff document information about your current Intel servers' environment. The following chart is an example server profile matrix.

Server Name	CHICTX02	CHIFPS01	CHIDB02	CHISMTP01	CHISMTP02	CHIEXC01
OS Type	NT SP6	2K SP3	2K SP3	2K3	2K3	2K3
Function	TSE	File/Print	SQL	SMTP	SMTP	EXCH
Proc MHz	600	1800	1800	2700	2700	3200
# of Procs	2	1	1	1	1	2
Avg Proc Utilization	65	15	35	20	23	31
Utilization Variability 1-5	3	1	2	1	1	4
Phys Mem in Use	750	350	750	250	270	1450
Net I/O						
Disk I/O						

The matrix includes critical server metrics, including:

- Number and speed of processors
- Average utilization, including a variability factor where a 1 signifies consistent utilization, and a 5 signifies extremely variable utilization.
- Physical memory in use
- Network I/O (Lo, Med, Hi)
- Disk I/O (Lo, Med, Hi)

Other factors critical to your environment should be included in the matrix. Tools such as "perfmon" can be used to obtain the information required by the matrix.

VM Strategy Development and Design

Now that the groundwork has been laid, the business objectives and critical success factors have been understood, and the stakeholders have consensus on what we are trying to accomplish, the technical aspects of the virtualization strategy can be developed, including:

- Identification of virtualization candidates
- Development of the design using best practices
- Server farm design:
    - Storage connectivity
    - Cluster connectivity
    - Network connectivity
    - Switching
- Development of OS "templates," sometimes known as "Golden Masters"
- Recoverability methods
- Management processes
- Provisioning processes

Guest Selection/VM Model

Deciding which servers to place in a VMware environment is part expertise and part an exercise in simple resource calculations. When a server is requested during the provisioning process, a decision will be made to determine if the server will be physical or virtual. This decision should be based on two factors:

- The physical resource requirements for the server
- The number of users or amount of activity the server will support

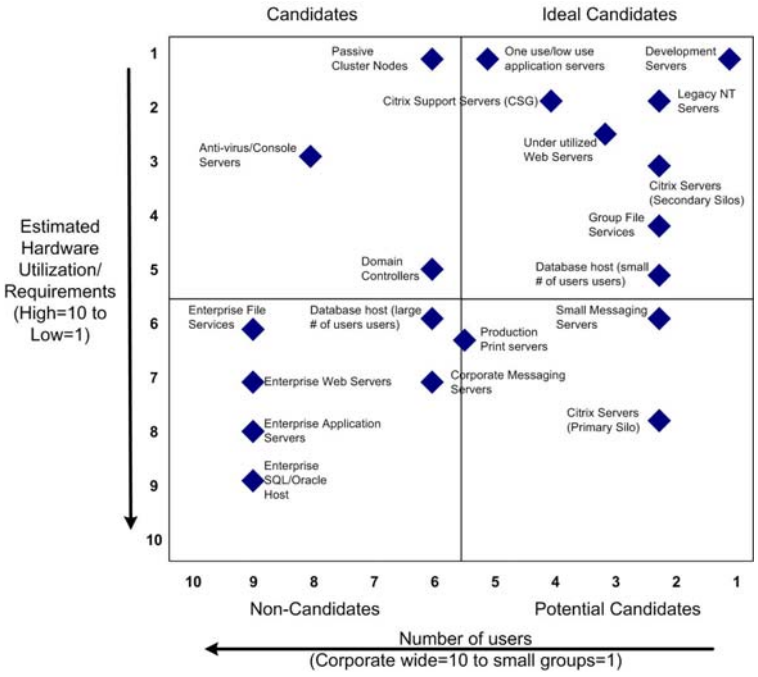
Often, these two factors are very interrelated and can increase or decrease at the same time. A good example of this would be a simple database server. Being a database server by itself does not rule out the possibility of being hosted in VMware. If the database server will be built for a small number of users (say 40 or 50), it is likely that its hardware requirements will be extremely low (possibly lower than even the resources a standard single or dual processor server may provide). In this case, the server may be an ideal VMware candidate.

Turn this example around to a database server that will start with 40 or 50 users but will eventually service hundreds or thousands of concurrent users. This server's/application's requirements may require more processing power and memory than a standard dual processor server. In this case, the major benefit of moving the server into a virtual environment (to save money on hardware by allowing server resources to be shared by multiple servers) will be undermined, because the candidate will most likely consume a large portion of a single host's resources, leaving little, if any, room for other virtual machines.

The "ideal" candidate is a server/application that requires few physical resources (processor, memory, disk, etc.) while at the same time being its own "standalone" server. By looking at the server's true resource requirements, you can determine if it would use (on a normal basis) less of the hardware resources than a single physical server would provide. In most cases, physical servers are over-engineered by a large margin to allow for growth.

This over-engineering generally applies to all resources, including processor, disk, network and memory. Over-engineering is not necessary with VMware, because resources can be maximized and resource share allocation changed as server requirements mandate, thereby maximizing all your hardware usage.

Deciding which servers are a good fit for virtualization is not always cut-and-dry. Based on some industry best practices and assumptions on utilization, we have developed the chart below. This chart creates a "rule of thumb" for server types. As always, there are exceptions to every rule, but the basic principals shown in this chart of comparing user load and hardware utilization will apply whenever you select a VMware candidate.



An Ideal Candidate?

As seen above in the candidate selection model, legacy NT servers are an ideal candidate for a move to virtualization. Many organizations have hundreds of servers nearing end of life. Many of these servers are used for point solutions by smaller departments and/or groups. These servers tend to have low processor and memory requirements, making them perfect candidates for virtualization. With today's 3 GHz+ processors it is

possible to virtualize a significant number of legacy machines running Windows NT 4 onto a single VMware ESX host with four fast processors.

Just use simple math: Six servers with 500 MHz processors can run on a single processor box running at 3 GHz. The real number is actually higher because the current servers are most likely not running at full processor speed at all times. Therefore, it may be possible to obtain efficiencies of 25-to-40 servers to 1 using these technologies.

The CBA

The following Cost Benefit Model and Analysis demonstrates the potential cost savings of the legacy NT server solution. The analysis also points out some of the soft benefits of moving to a virtual server environment.

As an example, we'll use the scenario discussed above. The ACME Corporation has found that they have 100 legacy Intel servers running Windows NT 4 or Windows 2000 that are past end of life. These servers host important applications and services, but their hardware is no longer viable. We plan on replacing these servers with several larger virtualized servers using the VMware ESX Platform. ESX will allow us to achieve our goals by supporting extremely efficient use of our hardware.

The following assumptions were defined for this analysis:

Assumptions	
Internal staffing in hours–Need involvement from Architecture, Intel engineers, application development managers, developers, DBAs, and storage	*600*
External consulting in hours	*600*
We assume there is one application per server	
VMware server cost	*$25,000*
Average non-VMware server cost	*$7,000*
Server CPUs (4-way)	*4*
Total VMs per physical server	*20*
SAN connections per ESX host	*2*
SAN connections per physical machine	*2*
SAN connection cost	*$1,400*
Network connections per ESX host	*4*
Network connections per physical machine	*2*
Network connection cost	*$200*
Legacy servers that can be migrated to VMware	*100*
Racks and UPS costs per server	*$2,000*
Internal staffing rate	*$50*
External blended staffing rate	*$150*
Cost of 16 hours to procure and set up physical server	*$800*
Cost of 1 hour to procure and set up physical server	*$50*
Cost of SAN storage per GB	*$100*
Average GB used for VMware guest disk	*15*
Host maintenance per year per host in hours	*24*
Management software cost per processor of host	*$400*

Summary of the Assumptions

- We have forecasted that organizations will require substantial resources both internally and externally to properly design an enterprise solution supporting 100 servers today and many more in the future.
- Hardware for the host servers was designed as a quad processor (3 GHz+) with 12 GB of RAM and at least four 36 GB SCSI drives (boot).
- Servers from IBM, HP, etc., are expected.
- These systems will also be SAN- or NAS-attached to allow for movement between hosts using VMware VirtualCenter. This configuration also supports excellent DR service levels via replication to hot sites or an alternate data center.
- We have made this analysis fairly conservative, assuming only 20 VMs per quad processor server. In your projects, a substantial increase in this number may be achievable depending on the mix and use of servers in your environment.
- We assumed two man days to build a physical server, but only one hour to build a virtual server. These numbers have been borne out in the projects we're working on. The VM provisioning process simply copies a "Golden Image," to which several changes are applied via a script. Then the server is brought online.
- The other assumptions are self-explanatory.

Analysis

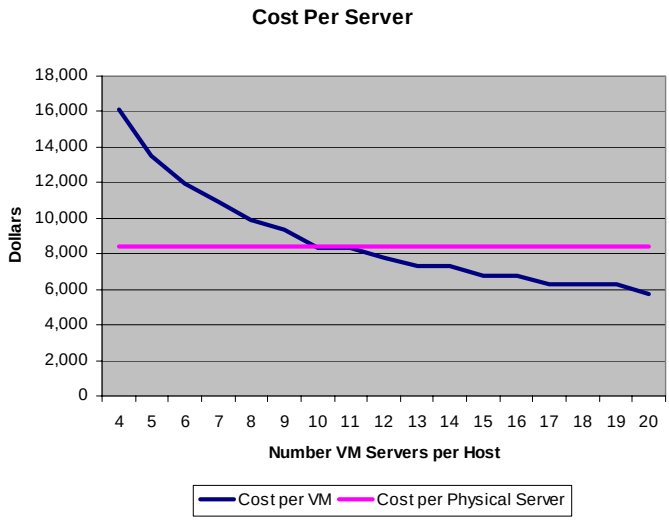
For this analysis, we compare an infrastructure built with 100 physical single and dual processor servers with that of several larger servers running VMware ESX. The cost of the VM approach includes the physical hardware, staff costs, consulting costs, setup costs, software costs and yearly maintenance for a three-year horizon. We used an expense rather than amortization model for this analysis to keep the model simple. However, similar results could be obtained through amortization and a calculation of NPV.

Findings

The following spreadsheet shows that virtualization has a strong and immediate payback on the initial investment. For the model described above, the cost savings alone are more than 30%, with the virtual design three-year cost of $576K versus the physical server design cost of $840K. While this is a significant savings, we believe that the real-life savings will be substantially higher, as companies will be able to load more legacy servers on each VM host compared to the model used here.

Legacy Hardware Upgrade Project	QTY	Units	Unit Cost	2004	2005	2006	Total Cost
Costs with VM							
Internal staffing	600	Hours	$ 50	$ 30,000	$ -	$ -	$ 30,000
External (vendor) staffing	600	Hours	$ 150	$ 90,000	$ -	$ -	$ 90,000
HW							
Physical servers	6	Servers	$ 25,000	$ 150,000			$ 150,000
SAN port purchases	12	New SAN ports	$ 1,400	$ 16,800			$ 16,800
Network port purchases	24	New network ports	$ 200	$ 4,800			$ 4,800
Racks and UPS	1	10 servers/rack	$ 2,000	$ 2,000			$ 2,000
SAN disk	1500	SAN Space GB	$ 100	$ 150,000			$ 150,000
Procurement and setup of physical servers	6	1 hour per server	$ 50	$ 300			$ 300
Yearly host maintenance	6	host/year	$ 1,200	$ 7,200			$ 7,200
SW							
VMware software	6	ESX licenses	$ 10,350	$ 43,470			$ 43,470
VMware ESX support and subscription	6		$ 2,318	$ 9,736	$ 9,736	$ 9,736	$ 29,207
VMware Virtual SMP 2-way	6		$ 3,450	$ 14,490	$ 14,490	$ 14,490	$ 43,470
Management and provisioning software	24	Per processor	$ 400	$ 9,600			$ 9,600
Total Cost				**$ 528,396**	**$ 24,226**	**$ 24,226**	**$ 576,847**
Costs Without VM							
HW							
Physical servers	100	Servers	$ 7,000	$ 700,000			$ 700,000
Network port purchases	200	New network ports	$ 200	$ 40,000			$ 40,000
Racks and UPS	10	10 servers/rack	$ 2,000	$ 20,000			$ 20,000
Procurement and setup of physical servers	100	16 hours per server	$ 800	$ 80,000			$ 80,000
Total Cost				**$ 840,000**	**$ -**	**$ -**	**$ 840,000**
Difference				**$ 311,604**	**$ (24,226)**	**$ (24,226)**	**$ 263,153**

In fact, the chart below shows the decrease in the cost of each server in the overall solution as the number of virtual machines provisioned per host increases. The break-even point for VMs per host is only 10, while the cost of a VM goes down rapidly to under $6K at only 20 VMs per 4-processor host.



There are also many non-financial advantages to this model:
We have built in N+1 redundancy to this model, allowing for many operational benefits, including:

- Near instant recovery of a failed server in the environment.
- The ability to perform hardware maintenance with extremely brief downtime.
- The ability to provide higher performance to a particular server if a special need arises. For example, during the year-end close cycle, an OLAP server may be moved to its own server and allowed to utilize the entire capacity of the server for processing.
- VMs can also be moved around to spread out the processing load.

- Disaster recovery service levels can be increased in several ways, including:
- Nearly instant recovery in hot site if SAN/NAS replication is utilized.
- Fast and easy recovery in hot site from tape backups.
- Recovery on any ESX-supported hardware. This is a major benefit, as most vendors will not guarantee exact hardware for recovery, which necessitates expensive scripted solutions to enable recovery on alternate hardware. With VMware, ESX is installed on the hardware and the VMs can be restored as files within the host to return to a functioning state. Of course, data must be restored using normal application restoration procedures.
- One of the main benefits of this model is that new hardware can be used even if it would not otherwise be supported by the legacy operating system. At some point, most manufacturers stop support of new drivers for legacy systems.

Yes, an Ideal Candidate

We have shown here that legacy NT servers are an ideal candidate for virtualization. There are many others. Application of this selection process and a simple cost benefit analysis should show you where the opportunities in your organization lie.

Developing the Deployment Plan

Identifying Critical Success Factors

As with the strategy development process, CSFs will help ensure that the deployment process will meet the expectations of technical and management stakeholders. Examples of CSFs for your virtualization deployment plan will likely include:

- Zero impact on production operation
- Availability of appropriate skilled technical resources
- Development of key processes and procedures prior to production
- Bulletproof rollback plan
- Organizational deployment methods, policies, and procedures will be followed

P2V tools will be used where possible to compress time and resource requirements.

Identifying and Mapping Project Tasks

The following approach is used to develop the steps required to complete the project.

Brainstorm Tasks
Brainstorming the tasks with a group, including someone who has done it before, is an effective way to understand at a granular level what tasks or activities must be completed and in what order. The "Post-it" note method works well.

- Group Tasks into Stages
- Group tasks into stages based on their relationship to each other. Major stages may include:
- Procurement
- Test lab engineering
- Solution engineering
- Provisioning process for hosts
- Provisioning process for VMs
- Create VM host design
- Create VM platform images or "templates"
- Build production infrastructure
- Pilot
- Perform recoverability and DR testing
- Migration
- Create As-built documentation
- Create standard operating procedures
- Transition to production support.

Identifying Dependencies

Once you've brainstormed the project tasks and grouped them into stages:

- Determine each tasks' predecessors (what must be done before you can start this task)
- Determine expertise needed to complete each task
- Determine how long it will take (in hours/days, or "duration") to complete and how much work will be involved.

Build a Schedule from the Mapped Project Tasks
Having identified the task dependencies, you are now equipped with the information to build an initial project schedule with Microsoft Project or similar tool. "Initial," because you have not yet taken people resource requirements into account.

Identifying Necessary Deployment Roles

While identifying task dependencies, we also determine the expertise required to complete each task. By grouping areas of expertise, you can develop deployment roles around different sets and levels of expertise and experience. This will enable you to identify and optimize project resource usage based on the availability of capable resources.

Also, by combining roles you will be able to define actual resources to fill those roles within your organization and to determine what needs will be required from outside your organization to successfully complete the project.

This is illustrated in the chart on the next page.

The following chart is an example of required roles and skill sets by role.

Role	Description
Deployment Manager	Technical Project Manager. Assures that project stays on track from a day-to-day point of view. Interface to engineers, allowing them to keep working when communications with mgmt and others is required.
VMware Engineer	Expert in VMware technologies. Will set up the systems, document the technology, and perform the P2V migrations.
Application Engineer	Will work with the team to ensure the proper installation and testing of the application.
Server Engineer	Will help with server-related tasks such as racking equipment, installing OS, and other server-related tasks.
Senior Server Engineer	Will work on the team to help design and install the server components of the design. Will work on security configurations and GPO settings, etc.
Senior Technical Architect	Will be involved for oversight and to provide expert technical knowledge, when required.
Database Administrator	Will aid the team by deploying SQL Server components.
Technical Writer	Will work on the documentation provided by team members to make it professional and readable.
Senior Network Engineer	Will provide expertise with switch design and testing, as well as data center build-out.
Senior Scripting Engineer	Will provide scripting skills for automation within the environment.
Backup Engineer	The tasks performed by the backup engineer revolve around recovery of these systems.
Performance Engineer	This resource will help write and test systems using automated scripts.
User Acceptance Testing	These are users tasked withy testing the solution prior to production.
Technical Approvers	Managers that can approve each step of the technology as it is designed, tested, and deployed.
Storage Manager	Responsible for delivery of SAN/NAS storage to the infrastructure environment.
Storage Engineer	Will provide storage to the VM environment as needed. Will help with the engineering of the Host and VM configurations.
Application Owner Management	Staff responsible for the application(s).
Principal Consultant	A high-level consulting resource.
Management Approvers	Upper level managers that make Go/No Go decisions and provide financial approval for the project.
Procurement	Procurement staff members.

What's next for your organization?

So, what's next? In our experience, we see forays into server virtualization often focusing on spot solutions rather than on the development of a foundation for a strategic, long-lasting infrastructure. Because the potential benefits are so significant, having a diligent, big-picture view at the outset is essential to fully realizing the benefits of your ESX environment.

Accelerate is a big-picture, road-tested process for designing and deploying network and systems infrastructure, including the latest server virtualization technologies. Accelerate is a rapid, staged process that starts with facilitated design and planning sessions and centers on our unique deployment management teams.

About GlassHouse Technologies, Inc.

GlassHouse Technologies is a global provider of IT infrastructure services enabling organizations to consolidate, virtualize and manage their IT environments. GlassHouse delivers services through Transom[SM], a unique process framework comprised of software tools, proprietary methodologies and best-in-class consultants. We reduce costs, decrease risk and improve service levels by providing accelerated, measurable results, vendor independent solutions and transparency in the IT environment. GlassHouse focuses on the storage/data protection, virtualization and data center markets.