IT infrastructure flexibility
White paper
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Designing IT infrastructure for business flexibility and competitive advantage.

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Introduction: Nothing endures but change

Change is inevitable. As a professional in charge of an IT infrastructure, the very word change may conjure up work-related nightmares. Frequent and sometimes daunting changes may bring back memories of times when, with little forewarning, you had to implement and put into production a new application. This meant finding, configuring and testing the necessary hardware and software in a matter of weeks. Unfortunately, past situations like this pale in comparison to the sudden, frequent, large-scale changes that lie ahead.

As the Internet continues to revolutionize computing, with globalization and commoditization intensifying competition, the pace of change is staggering. Success requires modular, flexible and innovative business processes—and an IT infrastructure that is nimble, responsive and constantly available. In the *2006 IBM Global CEO Survey*, 87 percent of chief executive officers (CEOs) stated that they believe fundamental change is required to drive innovation. At the same time, only one in ten professed to believe that his or her organization can respond quickly and effectively to changing marketplace conditions. Why? Many CEOs in the IBM survey attributed their organizational paralysis to IT infrastructure limitations. So as an IT or data center manager, it's time to ask yourself this critical question: Are you prepared to accommodate business and application changes no matter how frequently and rapidly they may occur?

What do a car race and an IT infrastructure have in common?

Quick changes, on the fly, when the stakes are high. During a race car pit stop, seven people completely refuel a car and change all four tires in a mere 12 to 14 seconds. It takes skill, planning, coordination and innovative design. Special lug nuts are attached to the wheel with adhesive ahead of time, and stud threads are designed for quick, accurate positioning.

Highlights

To keep up with business leaders' demands for frequent and rapid business process changes, IT managers must increase IT infrastructure flexibility.

In the business world, IT managers must also make changes quickly and not miss a beat in the availability and performance of mission-critical applications. More complex than lug nuts, clearly—flexibility must be incorporated into the existing IT infrastructure, so that you can manage business changes without disrupting ongoing operations.

This paper explores the major inhibitors to IT infrastructure flexibility and introduces five key approaches that can help you begin to develop a more flexible infrastructure. So you will be prepared to respond to rapid-fire business and application changes and stay ahead of your competition.

Infrastructure flexibility inhibitors

"*Can anybody remember when the times were not hard and money not scarce?*"
—Ralph Waldo Emerson

Common inhibitors to existing infrastructure flexibility include physical limitations, personnel skills and availability, budget constraints and technical hurdles.

This quote from the mid-1800s rings true even in today's business world. Yet it does seem that IT issues become more and more challenging as technology advances. As you begin to adapt your infrastructure for flexibility and change, you will likely face four common inhibitors:

- ***Physical limitations.*** *Raised floor space and power and cooling are not only expensive—their limits can hinder change and growth.*
- ***Personnel bandwidth and skill.*** *IT staffs are often too consumed with running and maintaining the existing environment to learn and implement new technologies.*
- ***Budget constraints.*** *With ever-tightening budgets, management is forced to make investment trade-offs. The more you spend keeping the current infrastructure going, the less you have to fund new solutions and capacity.*
- ***Technical hurdles.*** *Traditional systems (server, storage and middleware) are hampered by physically connected, siloed application stacks and single-workload systems. These systems often lack the processing power, memory and mixed workload support needed for flexibility and change.*

Highlights

By overcoming common flexibility inhibitors, you can begin to reallocate resources toward solutions specifically designed to support and enable change.

No surprises, right? The issues are universal. Each one is difficult in itself, and combined, well, it's no wonder your CEO worries about the company's dependency on IT flexibility to make the fundamental changes needed to drive innovation and competitiveness.

Improving flexibility in the data center requires gaining more control over physical, personnel, budgetary and technical inhibitors. As you overcome these challenges, you can begin to reallocate resources toward solutions specifically designed to support and enable change. This is how you will gain the performance and scalability to support growing workloads; the agility to handle fluctuations in capacity requirements; and the flexibility to support application changes rapidly, cost-effectively and nondisruptively.

The paths to flexibility

Change is good. You go first.

As an IT manager, you know that the catalyst for change is often the application layer. Even changes planned well in advance, such as upgrading to a new release of an enterprise resource planning (ERP) application, can have huge impacts due to their sheer size and complexity. Less predictable and just as demanding are large-scale changes driven by organizational dynamics or the implementation of new application layer models such as Web services and service-oriented architecture (SOA).

Solutions optimized for particular workloads can help you better address major application changes through simplified deployment, operation and support.

Addressing major application changes begins with this important question: Do your server and storage resources have the functionality, capacity, performance and availability necessary to handle the workload requirements? For a complex, business-critical application, the best approach is to find a solution optimized for that particular workload. This will simplify your deployment, operation and support efforts and provide flexibility for changes down the road.

Highlights

Long-term, not-yet-defined organizational demands will require a whole new level of IT infrastructure flexibility based on five key areas.

Beyond the specifics of addressing a major new application change, you must set the stage for longer-term, not-yet-defined demands and requirements throughout the larger organization. This calls for a whole new level of IT infrastructure flexibility. The following are five key areas to evaluate as you work to achieve long-term IT infrastructure flexibility:

- ***Simplification through standardization.*** *Embrace open standards and protocols and deploy consistent technology (hardware, software, middleware and networking) throughout your organization, consolidating resources where it makes sense. This will improve manageability and lay the groundwork for future computing models.*
- ***Scale up and scale out technology decisions.*** *Establish a flexible scaling approach, using the right technology and a consistent set of tools to dynamically optimize performance, capacity and cost.*
- ***Virtualization.*** *Free your applications from the limits of physical boundaries to maximize flexibility and efficiency.*
- ***Dynamic automation.*** *Let your system take care of service management and provisioning so you can oversee more resources with fewer personnel, allowing personnel with key skills to focus on activities that grow the business.*
- ***External hosting.*** *Leverage outside providers with deep expertise in creating flexible infrastructures to host the environment, so you can focus on your core business instead of on how to manage your IT infrastructure.*

Highlights

Reactive, fragmented approaches to IT infrastructure growth and management have given way to the need for simplification and standards.

Open standards can help you efficiently support your business while simplifying growth and change.

Simplification through standardization

Why is it that simplicity always seems more difficult than complexity? Especially when you set out to transform a complex IT infrastructure into a simpler one. This is the job of an IT manager: streamlining an IT infrastructure that was developed over time, by disparate teams using different approaches. The reactive, fragmented approach that characterized the past few decades is no longer viable. It's too expensive and nearly impossible to keep up with the urgent pace of change and the mandate for continuous availability. A flexible IT infrastructure starts with simplifying the existing environment and establishing standards for the technology itself, along with the processes to manage and govern it.

Standards

To guide your simplification strategy, you'll need to understand the components of the overall business model, including people, processes and technology. Then you can develop appropriate IT standards for consistency in hardware, middleware, applications and operating systems across your organization. Embrace and leverage open standards and protocols to enable vendor neutrality. These measures will help you efficiently support your business, while simplifying growth and change. A structured process is key; if you don't have the in-house expertise, it is worth it to seek help from an organization with proven experience. This will be the foundation of your long-term strategy, so it's important to get it right. Further standardization of flexibility can be driven as a companion to new application models like SOA or Web services. Reference architectures for SOA provide guidance at not only the application and service layers, but also at the management support and infrastructure layers.

Highlights

Server consolidation can help reduce hardware and software costs while reducing management and security challenges.

Consolidation

Physical server and storage consolidation can provide additional flexibility in supporting the workload mix. There are many benefits to centralizing workloads and data from multiple systems in different locations onto a single system. You can reduce hardware and software costs, lessen the strain on physical and personnel resources, and improve security and manageability through centralized control of applications and access. A typical approach is to consolidate like for like (for example, multiple servers onto a single server). A blade solution can take this one step further. The blade form factor combines servers, storage and networking into a single unit that can significantly simplify your infrastructure and ease management. Also, with standards for compliance and interoperability, driven by consortiums like blade.org, you can be confident that your blade investments are sound and will provide a durable infrastructure for future change.

Scale up and scale out technology decisions

Choosing the best way to scale technology depends upon your unique processes and workloads; modular hardware systems designed for upward scalability can be ideal for addressing current and future requirements.

Should you scale up, scale out or use some combination of the two? What technology will best support the type of scaling you need and enable maximum flexibility? The answer, of course, is it depends. The right scaling approach depends upon the unique characteristics of your business processes and application workloads.

Scale up

Scaling up means allocating more physical resources, such as processors or storage, to a single physical system to improve performance and throughput. Applications such as databases can benefit greatly from scaling up—for example, increasing the number of processors from 4 to 8 to 16 or increasing the number or capacity of storage devices. Modular hardware systems designed for upward scalability are ideal for addressing current needs and adapting to future requirements. With a scale up approach, it's important to select systems designed to optimize workload balance and availability.

Highlights

The scale out approach enables flexibility and swift change and is ideal for maximizing the performance of applications like Web, networking and telecommunications services.

Blade form factors enable you to "plug in" new servers, storage or other hardware in seconds, and their integrated nature helps reduce power consumption.

Scale out

Scaling out refers to running an application or storing data across multiple physical systems in parallel. This approach is ideal for maximizing the performance of applications like Web, networking and telecommunications services. Effective scale-out implementations must take into account the workload management implications in the middleware layer. Specifically, as the hardware resources expand, the software layer must be able to effectively support that expansion. Beyond software considerations, modular servers and storage specifically designed for outward scalability enable flexibility and swift change.

Blade form factors, for example, allow you to insert new server, storage or other hardware into a chassis in a matter of seconds, without the cabling required for traditional rack or tower servers. Also, through compliance and interoperability standards, blade architectures can be flexible through generations, meaning today's chassis is designed to support tomorrow's blade. Blade systems can automatically provision operating systems and applications when new hardware is detected and can even notify load balancing software that a new application instance is online and ready for work. The benefits can be tremendous. A large telecommunications company brought the time required to add a new server down to half a day by switching from rack servers to a blade solution.[1] Due to the integrated design of a blade solution's shared power supplies, other devices—such as internal switches and bridges—may use less power than stand-alone versions. As a result, the aggregate power savings of a blade solution versus one unit servers and related external equipment can be as much as 30 to 40 percent.[2] That's money that can be invested to further improve infrastructure agility.

Highlights

A mixed approach to scaling may be best if you have a combination of applications that can perform well on smaller servers along with applications with high security and data volume requirements.

Mixed approach

In many cases, a combination of scaling up and scaling out is the best solution for business needs. For example, today's ERP applications can perform well on smaller "scale out" servers, while the associated databases, which have high security and data volume requirements, are better suited for modernized, powerful "scale up" systems. In other cases, applications are deployed on smaller servers, such as blades, throughout the company, while a wealth of existing code remains on security-rich mainframes.[3] A mixed approach is equally important in the storage environment. A modular, tiered storage infrastructure comprising one or many different classes of devices can scale up, scale out or both to deliver the performance, capacity and cost needed for a given application.

Some newer servers and storage devices have the ability to dynamically allocate or deallocate additional processor or storage capacity to scale up or down as needed. The best part of this capacity on demand capability is that you only pay for extra capacity when you need it.

Virtualization, which is now possible in multiple layers of the IT infrastructure, is a key flexibility enabler.

Virtualization

Perhaps the greatest advancements in flexibility have come in virtualization, or the decoupling of the logical environment from physical hardware. Virtualization is now possible in multiple layers of the IT infrastructure—and each layer can play an important role in increasing flexibility. There are two general categories: workload virtualization and hardware virtualization (server and storage).

Highlights

Automated workload virtualization enables you to deploy new applications and features without interruption and avoid server outages.

Using dynamic application mobility, you can seamlessly move active work between physical locations, reducing disruptions during maintenance or upgrades.

Workload virtualization

In the application layer, workload virtualization, through virtual run times, allows application and service workloads to run across a pool of resources. Workloads are intelligently routed across resource pools, and application resources are dynamically adjusted based on business priorities. In its simplest sense, this is analogous to an airport ticket counter. Instead of separate queues for each ticket agent, there is a pool of agents, and the next available agent helps the next person in line. Frequent flyers are prioritized based upon their various status levels, and agents can be moved around according to demand (for example, between international and domestic counters). In the IT world, workload virtualization can be automated and managed across multiple environments. This enables you to deploy new application versions and features without interruption and to mitigate common server health problems before production outages occur. Application containers provide another important workload virtualization mechanism. Here the operating system and middleware create virtual operating system environments for each application, supporting maximum security and availability.

An emerging technology takes workload virtualization a step further. Dynamic application mobility lets you move work, while active, from one physical location to another seamlessly and transparently. For example, a virtualized application that is running and connected to active users can be stopped in mid-process, saved in state, moved while retaining all active connections and restarted without disrupting users. Back to the airport analogy, this is a bit like making flight connections in midair without getting out of your seat! This capability is especially useful for system upgrades and maintenance. Running workloads can be moved off of a system or storage device that is under maintenance to another device until maintenance activities are completed, with no perceived downtime to application end users. Dynamic application mobility is also valuable for some high-performance computing applications that have long-running, intensive computing jobs.

Highlights

The hardware virtualization functions that facilitate flexibility include sharing, emulation, aggregation and insulation.

Hardware virtualization

You'll want to take advantage of these four hardware virtualization functions that facilitate flexibility:

- ***Sharing.*** *Creating multiple logical images within a physical resource to enhance utilization and workload manageability. Examples include logical partitions (LPARs), virtual machines (VMs), virtual disks, logical unit numbers (LUNs) and virtual local area networks (VLANs). Sharing helps you increase the utilization of system resources and enables you to test, host and manage disparate workloads independently within one platform, so you can get more out of your infrastructure.*
- ***Emulation.*** *Creating virtual functions and facilities, which appear to exist within the physical resource, to provide compatibility, interoperability and adaptability. Some examples include IBM HiperSockets™ technology, Internet small computer system interface (iSCSI) and virtual tape. Emulation enables existing hardware to take advantage of new or future technology.*
- ***Aggregation.*** *Pooling multiple, separate, distributed resources so they appear as a single resource from the user point of view to simplify management and provide investment protection and scalability. Examples include storage area networks (SANs), virtual disks and Internet Protocol (IP) routing to clones. Aggregation is designed to enable high availability and failover to support mission-critical applications.*
- ***Insulation.*** *Separating the virtual resources from the physical resources, so you can add, replace or change hardware without disrupting running applications. Some examples include spare CPUs, capacity upgrade on demand and IBM SAN Volume Controller technology. Insulation gives you the flexibility to change hardware in your infrastructure smoothly and transparently.*

Highlights

By creating virtual servers so you can manage and run multiple operating systems on a single server, hypervisor technology makes the server virtualization sharing function more powerful.

Hypervisor technology makes the server virtualization sharing function even more powerful and beneficial. Instead of partitioning hardware, a hypervisor creates virtual servers so you can manage and run multiple operating systems on a single physical server. The most sophisticated "bare metal" technology provides fine-grained time-sharing of all resources, for the ultimate in efficiency and availability. The more prevalent hosted solutions use operating system services to allow for time-sharing. Hypervisors deliver virtual resources that can be quickly and dynamically adjusted to optimize service levels and meet new or changing needs. Also, because fewer physical servers are required, common management tasks are much easier.

To illustrate how hardware virtualization opens new avenues for IT infrastructure flexibility, let's look at some specific examples.

Virtualization reduces server provisioning time from weeks to minutes.

For common tasks such as server evaluation and testing, instead of physically adding a new box you can upload, configure and test representative workloads online. Then, upon successful evaluation, you can more easily select and purchase the configuration. When you are ready to install the new server, virtualization enables you to provision it in minutes rather than weeks, making IT the hero instead of the perceived roadblock to quickly addressing new application requirements.

From a storage perspective, you can use virtual disks (or LUNs) to adjust performance and capacity dynamically, sometimes without rebooting the operating system or disrupting applications. Using special SAN technology, you can create a virtual, comprehensive and modular storage appliance by pooling storage resources from multiple vendors into a common, centrally managed reservoir of capacity. This enables you to migrate data between disk or tape systems or both with no application disruption and zero planned downtime.

Highlights

Virtual disks and SAN technology can help you reduce storage management, administration and acquisition costs while improving storage utilization.

Applications can even continue to read and write data while the data is being moved from one subsystem to another. This is also useful when supporting diverse quality of service (QoS) requirements. An in-depth study of four companies representing government, manufacturing, healthcare and financial services quantified the potential economic benefits of this solution. The companies reduced their storage management, administration and acquisition costs, and improved storage utilization and availability of data-driven applications. The study calculated a 53 percent return on investment (ROI) and a payback period of 1.4 years. These figures are conservative, as they have been risk-adjusted to incorporate potential uncertainty in the calculation of costs and benefits.[4]

By combining hardware and workload virtualization, you can increase flexibility in your IT infrastructure dramatically. Many resources can be logically managed as one, reducing or eliminating silos and dynamically matching workloads with devices to achieve ideal performance and utilization.

Dynamic automation (or IT infrastructure, run thyself!)

Service management automation software makes it easier to keep up with the rate of IT infrastructure change by anticipating user and application needs and automating problem resolution.

Given the rate and pace of IT infrastructure change and the pressures and constraints on IT personnel, you must rely increasingly on the systems to do the work of managing and running themselves. These days, it is not too much to ask for IT infrastructures that automatically and dynamically manage and provision resources and services to most efficiently and effectively handle the many workloads put upon them. Service management automation software can enable IT systems to anticipate and address the needs of users and applications, and can automate (or at least expedite) problem resolution. Utilizing service management capabilities and IT Infrastructure Library™ (ITIL™) for best practice IT process and workflow automation can help enhance personnel productivity and enable flexibility.

Highlights

Dynamic automation software also aids in virtualization and management of logical environments. These capabilities provide consistent, centralized visibility and self-management of heterogeneous IT resources, increasing uptime and freeing IT personnel to proactively address the changes demanded by your business.

Automation is also a great way to reduce power consumption by automatically moving workloads to power-efficient resources and powering down unused resources, for example.

Dynamic automation can be applied, for example, to the management of power, heating and cooling. Applications exist to centrally and dynamically control data center power consumption to allow you to gain the flexibility to manage energy throughout the data center. Automatically moving workloads to the most power-efficient resources and putting to "sleep," or powering down, unused resources puts you—or your systems, rather—in charge of a major cost driver and flexibility inhibitor.

If you urgently need to increase flexibility or you're looking to free up personnel and budget, you might consider external hosting solutions.

External hosting

The final focus area for enabling greater IT flexibility is the option of external hosting. Hosting options cover a broad spectrum of solution areas and address multiple layers of the IT infrastructure (for example, servers, storage and network devices, and ERP, customer relationship management, supply chain management and other business applications). You might consider external hosting to free up personnel and budget, or you might look to leverage the hosting provider's sophisticated, flexibility-rich technology and associated skills. In the first case, hosting is a way to enable valuable IT personnel to focus on business-critical tasks and key projects aimed at improving your company's differentiation and competitiveness. In the second case, external hosting is a fast path for taking advantage of the first four key capability areas described in this paper—without hiring new employees or developing whole new sets of skills. In both cases, hosting can help reduce IT costs by leveraging the hosting provider's efficiency and economy of scale.

Highlights

You can use the technologies and capabilities described in this paper to rapidly and smoothly accommodate changes, and IBM can help.

IBM has the broad technology capabilities and services expertise that are necessary for the creation of a more flexible IT infrastructure—and we can help you start unlocking agility today.

Be ready for change

As an IT manager, one thing that you can be sure of is that changes will be coming more quickly and more often. But they don't have to be painful. By establishing a flexible infrastructure based on the capabilities and technologies described in this paper, you can be ready to rapidly accommodate changes with little to no disruption for your users and significantly less impact on you and your staff. You can trust an industry leader like IBM to help you take the next step, mitigate your risk and strengthen your IT environment to not only sustain change, but to thrive on it.

Why IBM?

Who, other than IBM, can deliver the technology capabilities and services expertise across this broad spectrum of IT infrastructure flexibility areas? Nobody. If you are ready to set your course on near- and long-term IT infrastructure flexibility, IBM is the clear choice to help you get there. IBM offers an extensive portfolio of modular, integrated solutions across hardware, software and services—all based upon decades of experience and industry-leading research and development. IBM has helped clients of all sizes and industries around the world successfully plan and implement standardization, scaling, virtualization, dynamic automation and external hosting. IBM is ready now to help you create a more flexible IT infrastructure to meet your specific needs for years to come, starting with manageable first steps that can unlock levels of agility previously unimaginable.

For more information

To learn more about how IBM can help you move toward a flexible infrastructure, contact your IBM sales representative or visit:

ibm.com/itsolutions/businessflexibility/infrastructure

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1 This case study is an example of how one customer uses IBM products. There is no guarantee of comparable results.

2 According to comparisons of similarly equipped servers using IBM power configuration tools

3 *Secrets of SOA,* Larstan Publishing Inc., 2006.

4 *The Total Economic Impact of IBM SAN Volume Controller,* Forrester Research, Inc., 2006

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