Virtualiron

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The Next Generation Data Center

Delivering a more manageable, agile and cost-effective approach via virtualization

Companies are finding it increasingly difficult to manage their enterprise data centers today. They're highly complex, expensive to build out and difficult to reconfigure as needs change. The net result is a very high cost of ownership for a resource that is poorly positioned to meet the needs of the business.

Data Center Virtualization is a new approach to virtualization and data center management that enables organizations to take control of their data center by dramatically reducing the complexity associated with implementing, updating and managing IT systems. It enables companies to manage their data center more effectively and respond to the needs of their business more rapidly.

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EXECUTIVE SUMMARY

Today the data center is the foundation of most companies' IT infrastructure – the engine that dictates how efficiently and responsively companies run their business. While significant investments continue to be made in infrastructure and innovation, many data centers are overrun with application deployments, technology updates and system maintenance. As a result, data centers remain complex, challenging to manage and expensive to operate. Bottom line, companies are not getting the kind of return they should for the dollars they invest in their data center and they will have difficulty responding to the changing needs of the business if their approach to managing infrastructure does not evolve.

How did we get here? Over the past decade, macro IT trends like standardization, web-based applications, and multi-tier architectures have significantly changed the data center. At the same time, business demands drove companies to roll out one application after another on disparate hardware, operating systems and vendor software. This combination has led to data centers that are extremely complex and challenging to manage. Administrators have been forced to become very creative and savvy at finding new ways to reconfigure, redeploy, and upgrade systems. Making matters worse, the rapid IT expansion has caused a proliferation of servers that are woefully under-utilized, yet new equipment continues to arrive and require rapid provisioning. The overall result is high capital expenditures and operational costs that are inconsistent with the value being delivered. IT organizations must find new ways to align computing resources with their business initiatives and leverage new data center management tools to deliver the response and agility required to succeed.

Where do we go from here? Virtualization of the data center is one strategy that addresses today's data center challenges - delivering the agility, manageability, utilization and cost management that CIO's covet. Originally deployed as a mainframe technology, virtualization is not a new concept. It has been applied to various technology problems throughout computing history and is now getting renewed interest as an approach for managing standardized servers, racks, and blade systems. By taking virtualization approaches and applying them to commodity hardware, companies can greatly improve manageability and utilization, without losing the low cost structure and high flexibility of standardized, distributed systems.

Data Center Virtualization (DCV) is a new approach that enables a truly dynamic IT infrastructure - transforming the static, hard-wired data center into a software-based, dynamic pool of shared computing resources. This model is sometimes referred to as "utility computing". It provides simplified management of industry standard hardware and enables today's business applications to run on virtual infrastructure without modifications. The approach uses centralized policy-based management to automate resource and workload management to deliver "capacity on demand" with high availability built in. The separation of physical data center building blocks via virtualization techniques makes real time adjustment of the data center possible. Data Center Virtualization solutions are available today and enabling organizations to more rapidly respond to changing business demands and dramatically reduce the cost of managing and operating the data center.

DATA CENTER CHALLENGES AND TRENDS

Over the past decade, data centers have evolved significantly and become more complex. Several macro-trends are behind these changes:

Standardization

The computer industry has been steadily moving towards standardization at many different levels of infrastructure. Broad horizontal standardization of hardware components and software layers, each dominated by a few vendors has gradually been replacing the vertically integrated computer market where vendors combined their own hardware and software to produce single vendor solutions. Increasingly standardized components are being used for processors, operating systems, networks, network interfaces, switches, interconnects and storage.

Web and multi-tier architectures

Applications increasingly are divided up into layers with separate technologies deployed for each layer. Such layers include presentation, business logic and associated application servers and back-end database and file servers. This trend has led to a significant increase in the number of servers to manage.

Staged application development lifecycles

Data centers have been applying staged processes to develop, test, deploy, and manage applications. To support a single, mission critical application, IT required infrastructure for development systems, QA systems, staging systems (for updates and applying patches), production systems and stand-by systems for high availability. Sound data center practices required dedicating hardware and servers to a single system/workload to minimize complex intra-system interactions. This has led to over-provisioned hardware and an increase in the number of servers to manage.

Service level agreements (SLAs)

The critical need to meet businesses' SLAs led to very conservative capacity plans and system configurations. Without a practical way to provide modular additional capacity to applications, data centers had to purchase significant excess capacity for every application and at every tier. This capacity was usually wasted with no way to reclaim it.

Distributed and heterogeneous infrastructure

Today's enterprise data centers contain a proliferation of disparate, different-sized, single-function servers, each running specific applications – such as file and print, web services, e-mail, enterprise applications, databases, and more. During the previous decade, the tendency was to dedicate individual servers for each application to isolate it from incidents on other servers. Each of these servers was over-provisioned and overloaded with up to twice as much computing power and capacity as it might need to handle the heaviest project workload and meet spikes in activity. Making matters worse, to ensure availability, most of these servers were also backed by a second duplicate server, often passive, just in case the original server failed, exacerbating the glut of unused capacity.

IT OPERATIONAL CHALLENGES

The result of these trends is a proliferation of computers, storage systems, operating systems and databases leading to an application delivery infrastructure that is saddled with major challenges:

- **Under-utilized capacity and expensive infrastructure.** Thanks to the one-app-per-server model — and the passive backup-per-server availability strategy — the vast bulk of computing capacity is unused. Various analyst estimates suggest that in most large corporations, anywhere from 80% to a staggering 95% of the available server computing capacity sits unused 80% of the time. Despite this idle capacity, the data center continues to grow and grow, with new expensive servers being deployed for additional applications.
- **Complex environments that are difficult to manage.** Complexity is fast becoming the chief enemy of IT management. The variety in technologies and sheer size of the data center make it very labor-intensive and costly to manage. Even with new and more centralized management tools, analysts estimate that a typical large-company IT staffer cannot effectively manage more than 30 servers, forcing IT departments to either staff up or stretch existing staff thin. One result is that companies are spending anywhere between $7 - $10 to manage every dollar spent on physical hardware. Another is that IT departments spend 80% of their time managing existing application servers, and just 20% of their time on the new technologies that mean the most to the company's future.

- **Inefficient and inflexible systems.** Today's data center has a frustrating lack of flexibility — and a plodding re-provisioning and deployment model. Should an application need more computing capacity, IT staffers have two options: 1) take the application server offline and manually re-provision the server with more capacity, which can take hours or days, or 2) purchase a new (and most likely, over-provisioned) server and move the application to it, which might take weeks or months. Staging and deploying new applications can take weeks as well, sometimes months. These are no longer acceptable timeframes in an environment where users want additional capacity and new applications on demand, and where IT performance is measured against service level agreements cut with various internal departments and lines of business.

Enterprises cannot continue to operate in this fashion. Rising data center costs, shrinking data center budgets, and the demand for new resource-hungry applications and services are forcing IT to re-evaluate these "business as usual" approaches to data center management.

EMERGING TRENDS IMPACTING THE DATA CENTER

Data centers are evolving rapidly in response to these challenges and further evolution is coming from new approaches to data center management like "shared infrastructure" and "centralized IT." Emerging technologies like fast interconnects and standardized hardware are also making an impact.

Shared Infrastructure

Rather than keeping applications bound to specific servers and disk volumes, the underlying infrastructure will be shared. As application demand shrinks and grows, server and storage hardware will be continuously re-deployed to where it's needed. The net result: No longer will firms over-purchase hardware to support peak loads on every application.

Return to Centralized IT Infrastructure

IT organizations are returning to a disciplined, centralized IT infrastructure to deliver predictable service levels while controlling the escalating costs of hardware, software and human resources. This will concentrate more resources at a fewer number of data centers and enable corporations to manage and track computing growth more easily.

Standardized Hardware

Global 2000 companies are increasingly replacing proprietary systems with less expensive, standardized Intel- and AMD-based servers to run a variety of data center apps. The majority of tomorrow's applications will run on low cost, modular servers that scale to meet application demand.

High Speed, Low Latency, Standardized Interconnects

The emergence of high-speed, low latency standards such as InfiniBand (and in the near future 10Gb Ethernet with RDMA) that interconnect commodity servers with each other and to their I/O, will allow for the creation of distributed architectures for running resource-intensive enterprise applications.

COMPANIES TURN TO VIRTUALIZATION

Virtualization technology for storage, networking and computing is now available and being deployed in data centers. It replaces static, physical hardware with dynamic software equivalents. Computing and networking services are not tied to specific hardware or network paths. As a result, hardware resources are easier to share and manage since they are no longer dedicated to individual applications. Management tools allow administrators to move to a higher level of resource management so that it is no longer a matter of just dealing with boxes and their interconnections.

At the highest level, virtualization lets an administrator see multiple physical computing resources as a single logical entity that can be divided or grouped irrespective of physical realities like size, packaging, componentization and location.

Consider storage virtualization as an example. First generation storage virtualization, also known as logical volume management (LVM), is the best-known and most successful virtualization technology to date. LVM lets a company see all of its physical storage hardware, regardless of make or model, as a single shared storage resource — not, say, ten 5TB storage devices, but 50TB of raw storage. An administrator can use this resource to create storage volumes that are abstracted from the physical disks to store files larger than any single physical storage device can accommodate, or to create dedicated, isolated, virtual storage units that can be a fraction of the size of any physical storage unit, or that span multiple physical storage units.

More importantly, to deploy an application with LVM, all the manager has to do is "point" the application toward the unit, a task typically accomplished with one or two mouse clicks. So if, for example, administrators want to set up a data archive, they can simply create a dedicated virtual storage device from the capacity available on any number of physical devices on the network, and then point the archiving software to that device — which is a lot faster, easier, and less expensive than purchasing and connecting and configuring dedicated storage hardware.

The benefits of storage virtualization explain why the potential of server virtualization has such appeal. If you could virtualize your entire data center in the same way that LVM virtualizes storage hardware, you could create resources of any size and just point applications to them, as needed — dramatically maximizing utilization, streamlining provisioning, and simplifying server management.

EARLY SERVER VIRTUALIZATION SOLUTIONS FALL SHORT

Unfortunately, solutions most commonly marketed today as server virtualization, server partitioning, and server provisioning — fall far short of comprehensive server virtualization. None of these approaches liberates users from the physical restrictions of their server hardware. And all place significant and potentially costly limits on the virtual servers users can create, the ease with which users create them, and the applications that can be run on them.

Server Partitioning Software: Limited scalability and flexibility

Partitioning (also called server virtualization) is the ability to run more than one instance of an operating system on the same physical system. The concept originated from the mainframe world and has recently been applied to the standardized server space for certain infrastructure workloads (typically for networking applications such as DNS, file/print server, etc.) or for software development and test. For example, if a company has print and DNS servers, each consuming less than a tenth of a server, it could consolidate these workloads onto a single server, each isolated from the other as if they were on different physical computers.

> *"What VMware does is to take a large server and break it up into multiple small servers. . . I think the next wave, though, is to take multiple small servers and aggregate them into a single virtual machine. . .*
>
> *The whole idea is that I want to treat CPUs as a commodity resource, and I want to be able to build a computing capability for a particular application that is truly flexible. If the application only runs for a couple of hours every day, I want to be able to deploy it when it runs, and I want to be able to deploy it to something else when it's done.*
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> **CEO, Network Appliances**

Today's partitioning solutions are designed for optimizing usage of a single server with fairly well defined workloads. They are not designed for optimizing enterprise-class production applications across a data center. These solutions can definitely improve utilization of server hardware, and help consolidate servers, but only for light workloads. Plus, each virtual server you create can't use any resources beyond those contained on the physical server being partitioned — which means, among other things, that on standard servers, users can't scale any application beyond one or two processors. Simply put, partitioning can virtualize individual servers, but not entire data center infrastructure.

Server provisioning software: Limited applicability and scalability

Server provisioning software is often presented as another form of server virtualization technology aimed at resolving the inflexibility of the current data center. It lets data center administrators change which server boots an operating system image and its associated application – either by simply "pointing" the application to a particular server or by scheduling it to move there automatically at a particular time.

Provisioning can be used to rapidly stage an existing application on a new physical server, when that application outgrows its current physical server, or when the current physical server fails. In either case the software does all the work — the administrator never touches a physical machine.

Like partitioning software, provisioning software is good so far as it goes. It often improves upon manual provisioning, which comprehensive server virtualization would also do, but it is still evolving and needs to be more reliable and easier to use. Also, provisioning software improves efficiency only in situations where applications can be idle at different times. Lastly, it doesn't help reduce over-capacity or manage peak workloads.

A NEW APPROACH IS NEEDED

Imagine a world where IT can truly deliver "capacity on demand". A better and more flexible world where servers and hardware can rapidly be provisioned and applications easily deployed. A world where applications could be scaled up or down in minutes based on business demand.

Data Center Virtualization is a more agile, flexible, and cost-effective model for creating and managing data centers. An approach that increases the utilization of servers and decreases the number of manual, error-prone administrative tasks needed to manage these servers. An approach that enables IT staff to focus on strategy, and innovation, instead of wasting time, money, and energy dealing with the hassles of boxes, cables, configuration files, and patches. Data Center Virtualization helps IT spend more time fine-tuning and automating operations and less time reacting to fire drills, configuration errors and arduous reconfigurations.

Data Center Virtualization redefines data center management by making it dramatically easier and cheaper. It enables IT to use low-cost hardware and software components and enables systems to scale up and scale out on-the-fly, all transparent to applications. It also creates hardware independence so that applications can run anywhere in the virtual data center.

> *"Virtualization technologies are of increasing interest to organizations seeking both to cut costs and to optimize the use of their IT infrastructure. . .*
> *A dynamic IT infrastructure that is built using these technologies is more complex than a single machine configuration. So, organizations need to include provisioning and management software in their planning. Products, such as Virtual Iron's, offer the policy-based management environment that can support multiple server virtualization technologies. This would allow the organization to see a simple, consistent, coherent view rather than all of the complexities of the physical configuration."*
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> **Dan Kusnetszky, IDC Research**

DATA CENTER VIRTUALIZATION

Data Center Virtualization shatters the bounds of traditional virtualization capabilities and offers infrastructure-wide virtualization. Unlike the approaches described above, Data Center Virtualization is specifically designed to support enterprise-class applications and to combat all the inefficiencies and inflexibilities of today's data centers. This new "virtual data center" delivers an evolutionary computing model that essentially hides all hardware components from applications and the operating system behind an abstraction layer – presenting a simplified, highly manageable, and flexible collection of software equivalents.

The virtual data center is comprised of four types of components: processor, memory, storage, and network. A high-performance multi-fabric switch interconnects all components and enables a pooled logical grouping, often referred to as a virtual computer. The computing, storage, and network services are made available to the operating system that manages applications and the allocation of these services can be often be automated via policies.

Today's virtual data centers also take advantage of inexpensive standardized hardware, high-density components like blade systems, remote storage like Storage Area Networks (SANs) and network attached storage (NAS) and switched multi-fabric interconnects.

DATA CENTER VIRTUALIZATION CAPABILITIES

Data Center Virtualization offers several capabilities that go well beyond previous approaches to virtualization and data center management:

1) **Virtualize the entire server infrastructure, not just individual servers.** Data Center Virtualization lets users combine servers and hardware resources into seamless, sharable pools of computing resources.

2) **Completely decouple applications from the constraints of the underlying physical hardware.** With Data Center Virtualization, users can build virtual servers composed of any of the resources in that pool, regardless of the physical location of those resources. User can utilize processors and memory from two physical servers, storage from the network and then add additional processing power or memory from a third, and so on. Because the hardware interfaces are abstracted, applications only see the software equivalents, thus allowing underlying hardware to be changed, upgraded or maintained without the need to update applications and system configurations.

3) **Build servers of virtually any size — scale up or down, granularly, as required.** Build a server utilizing anywhere from a fraction of a processor to a group of large multi-processors. This server is created from a shared pool of interconnected server, storage and network resources. Additional resources from the pool can be dynamically added without impacting the running application to bring precisely the required computing power at any time.

4) **Deploy a new server and application in minutes.** Using a graphic management interface, users can point and click to assemble a virtual server in a few seconds. Users install the operating system and applications just as they would on a physical server — but without ever touching physical hardware.

5) **Re-provision any server in seconds, without downtime.** With a few clicks of a mouse, users can increase any virtual server's resources such as processors, memory, I/O, storage — or simply migrate a virtual server from one physical server to another with zero-latency. Users can do this without shutting down the application or ever touching physical hardware.

6) **Automate peak workload handling.** Set policies or write scripts to have virtual servers automatically scale up or down based on certain times, workloads or events.

7) **Eliminate the need to modify applications.** Everything runs as-is on virtual servers, just as it runs on a physical hardware. And Data Center Virtualization requires no additional operating system layers and is completely transparent to all business applications.

8) **Use industry-standard commodity hardware from any vendor.** Users start with existing hardware, and buy whatever value-oriented hardware makes sense in the future.

The ability to dynamically deploy computing power as needed is one of the key business drivers for applying Data Center Virtualization technology. It improves overall resource utilization by putting resources where they're most needed in real-time. Using Data Center Virtualization, applications consume resource capacity based on business demands, sometimes referred to as "dynamic infrastructure" or "utility computing".

The ease of administration of virtual data centers is another key business driver for applying Data Center Virtualization and the key to saving money, time and energy in managing IT infrastructure. Current generation data centers require a

large workforce of expensive system and network administrators to perform the same tasks repeatedly for multiple servers. The key to reducing this cost is achieving a smaller ratio of administrators to resources (servers, SAN's, networks) for all aspects of data center management.

"This type of virtualization promises to improve the efficiency, effectiveness and ability to deliver services rapidly in a data center environment."

CTO, Cisco Systems

System administrators spend a majority of their time installing new hardware, re-allocating hardware, updating patches and configuring similar servers. They accomplish this by repeating a proven sequence of steps for each system. In the virtual data center, a single administrator creates a reference software stack that contains a virtual server operating system and targeted applications. Once the image is fine-tuned and base-lined, it is used for other similar systems; hence the installation and configuration steps are performed only once. The image of the reference stack is placed in a common storage area for re-use across the other systems. Future upgrades and patches now only require updates to the reference image.

VIRTUAL IRON

Virtual Iron is a software provider that delivers a platform and management tool for Data Center Virtualization. The company works in highly competitive and dynamic industries that demand high levels of computing power and IT capacity such as Financial Services, Life Sciences, Manufacturing, Telecommunications, Health Care, Retail and Government. Virtual Iron also works with ASPs, ISP's, BPO's and SaaS (Software as a Service) providers who need to manage large web hosting facilities.

Three unique capabilities set Virtual Iron apart from other offerings in the market: (1) Infrastructure-Wide Virtualization; (2) Dynamic Pooling and Sharing of Computing Resources; and (3) Policy-Driven Resource and Workload Management.

Infrastructure-Wide Virtualization

Virtual Iron optimizes the utilization of all data center hardware resources and delivers high availability with less redundancy. And it does this on industry-standard hardware and operating systems. Companies use Virtual Iron's software to create virtual data centers – dedicated pools of standard-based resources typically organized around common needs. The virtual data center is subdivided into logical groupings called virtual computers, which are assigned to various applications within the organization as shown in the illustration. Administrators use a management console or software commands to place any subset of processor, storage, or networking component(s) in the virtual computer, rather than reconfiguring physical machines, cables, and switches. Each virtual computer is carved into a number of single or multi-processor virtual servers. Virtual servers run a fully-functional operating system and utilize assigned physical resources – such as CPUs, memory, HBA's (Host Bus Adapters) and NIC's (Network Interface Cards).

"The ability to treat a data center as a single virtualized pool of compute, memory, and I/O is clearly an ultimate goal of server virtualization. It also provides a comprehensive management interface that lets administrators manage an entire 'fabric' of physical systems and virtual machines … from a single GUI … It's an extremely powerful and flexible idea."

Gordon Haff, Illuminata

Dynamic Pooling and Sharing of Computing Resources

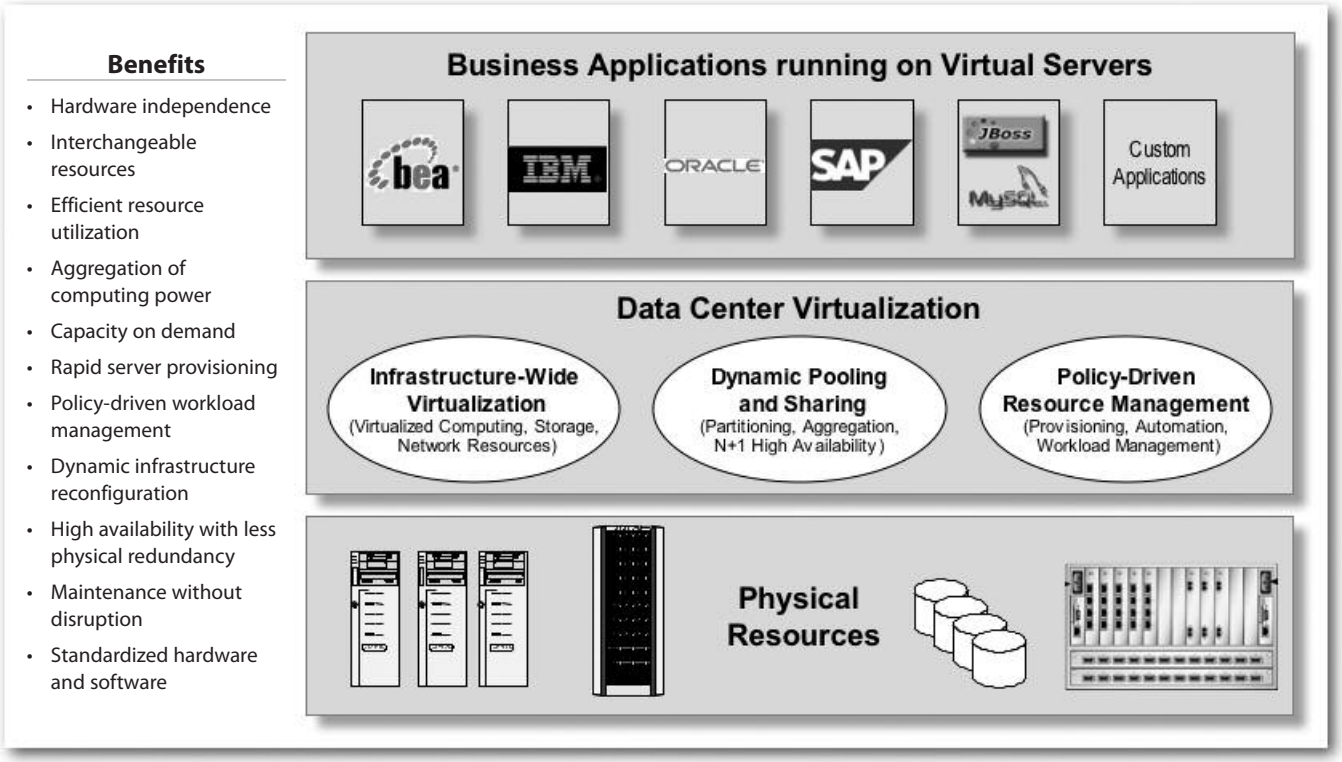
Virtual Iron handles peak workloads without over-scaling and accommodates changing application demands without service disruptions. The software is built from the ground up for enterprise application workloads – resource intensive applications that may run on multi-tier infrastructure requiring significant network bandwidth and access to large storage systems. The platform is optimized to minimize system overhead (less than 10% on average) and uses para-virtualization (tuning of the OS to the virtual platform) to deliver excellent performance. Virtual computers can be created by combining any number of single, dual, quad and 8-way physical servers.

Virtual Iron manages network and storage resources to include multi-pathing for redundancy and load balancing. Access to I/O devices is implemented via virtual adapters - Virtual Network Interfaces (VNICs) and Virtual Fiber-channel Host-Bus Adapters (VHBAs). Each VNIC and VHBA has its own associated Media Access Control (MAC) and World Wide Name (WWN) address. This level of virtualization allows the data center administrator to dynamically change the underlying physical hardware that is running a workload without making any changes to the SAN infrastructure (LUNs) or network infrastructure. Virtual adapters may be created dynamically to adapt to changing workloads without the need to install physical NICs and HBAs on a physical server. These I/O virtualization capabilities streamline system and application reconfigurations by eliminating the need to reconfigure all the individual I/O equipment involved.

Policy-Driven Resource and Workload Management

Virtual Iron's unique policy-driven automation simplifies the management of computing resources and enables rapid provisioning and deployment without increased administrative overhead. The software includes a management server that controls the "bare metal" servers and I/O devices. It also includes a web-based management console, referred to as Data Center Manager. The console allows the physical resources and virtual servers to be configured through a graphical interface. It is also used to create and manage policies that automatically maintain application availability and acceptable performance/response levels. These policies essentially automate resource management by triggering reconfigurations based on rules that detect exceeded user-defined performance thresholds, e.g. add another CPU to a

VIRTUAL IRON'S DATA CENTER VIRTUALIZATION



virtual server when CPU utilization is greater than 90 percent. These changes are done on-the-fly without impacting running applications. Policies can also be used to automate the migration of virtual servers to any virtual computer available.

VIRTUAL IRON IN ACTION

Virtual Iron's software solutions are being applied in a variety of scenarios to support major data center initiatives:

Data Center Consolidation

The hyper-growth of IT in the past 10 years and popularity of deploying applications remotely and outside of the data center has resulted in a proliferation of servers, storage systems, and operating systems. To make matters worse, most of these applications are on isolated, single-function physical servers that are over-sized and under-utilized.

Virtual Iron's software streamlines and automates consolidation. The solution consolidates a large number of applications onto a single physical server or onto a group of servers if you to need to scale up beyond the resources in a single physical server. The result is a "virtual data center" and dynamic infrastructure built out of industry-standard hardware and software, allowing customers to implement flexible, adaptable data centers that automatically adjust to changing business needs. Benefits include: fewer servers and OS images; up to 10X improvement in resource utilization; reduced risk of capacity shortfalls and service interruptions; and lower hardware and maintenance costs.

Capacity on Demand

Organizations are struggling to align computing resources with their business initiatives and as a result are unable to deliver the response and agility required to succeed. This alignment requires a dynamic computing infrastructure that allows technology to quickly and automatically match IT supply with business application demand.

Virtual Iron enables capacity to be reconfigured and allocated on-the-fly by making all resources available to any application in the system. The software allows virtual servers to be built from any resources in the data center, regardless of the physical location of those resources. Use a processor from one server, memory from two others, storage from an third, and so on. This avoids overbuying capacity (CPU, memory, I/O) for peak workloads and avoids the risk of running out of capacity. This approach increases utilization across the data center and delivers on SLAs (Service Level Agreements) more cost effectively and consistently.

High Performance Computing

High performance computing (HPC) harnesses the power of many CPUs and large amounts of memory to solve problems that require a large number of processing cycles and involve huge amounts of data. Traditional solutions, such as multi-way Unix servers and grid-enabled applications, are extremely expensive to develop, purchase and maintain. The high cost of rewriting applications to leverage HPC infrastructure, such as grids, and the inefficiencies in system management have hampered wider spread application of grid technology.

Virtual Iron's software enables users to create virtual servers consisting of multiple physical computers that run a single operating system avoiding the need for major application rewrites. The grouping of servers is often referred to as a "grid" and with Virtual Iron software, it is a grid running one operating system – not an operating system per server or node (Note: A server is often referred to as a node in HPC discussions). Virtual Iron combines the advantages of symmetrical multi-processing, grid computing, and clustering while being transparent to the operating system and applications. It enables distributed processing, most often required for scientific computing and automatically distributes load across servers via predetermined policies. In addition, the platform can be deployed with commodity hardware and software and take advantage of emerging computing platforms like blades instead of expensive proprietary systems.

Development and Test

IT organizations are under heavy pressure to reduce testing costs and shorten the cycle from development to production. The number of test scenarios and use cases has exploded because of all the permutations of hardware, app servers, firewalls, browsers, and databases that need to be supported. Development organizations need to work closely with their QA and production/operation counterparts to orchestrate these complex development, test, staging, and production environments that are rampant with configuration idiosyncrasies.

With the Virtual Iron software, test and staging configurations are easy to change, can be run concurrently, and do not require a physical machine for each configuration to be tested. IT can partition a single physical server into dozens of isolated development environments and coordinate configurations and footprints between the development, test, staging and production environments via virtual servers. They can also duplicate the exact production environment on virtual servers for testing purposes and

eliminate the repetitive configuration tasks required to keep test and production systems identical (simply move or copy virtual servers between systems). Developers can simulate complex networked applications on a single server. Hardware restrictions are removed by allowing teams to use physical hardware that does not need to be identical across development, QA and production. For example, one can develop on a virtual server running on a dual processor and move to a 4-way processor without any software configuration changes.

Virtual Iron's approach reduces hardware requirements, improves time to market by reducing the time to provision and configure servers, and shortens projects via automated and streamlined processes for handing off software from development to test.

> *"I have been waiting 20 years for a company to solve this problem. In the past, the need to re-write applications [to achieve reliability and performance] was prohibitively time and resource intensive. With Virtual Iron, I don't have to do that. This is a major breakthrough."*
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> **R&D Project Manager, Northrop Grumman**

High Availability

Enterprises are making large investments in infrastructure to ensure that applications are always available for their business users and customers.

Virtual Iron takes high availability clustering a step further by allowing multiple "primary" virtual computers to share a "secondary" server and enable any of the primary servers to fail over the single secondary virtual computer, reducing the required hardware. This is often referred to as "N+1 failover" which is defined as one shared secondary server for N primary servers. Virtual Iron can handle multiple concurrent failures under the same N+1 failover scenario, with the ability to dynamically scale as needed. It also enables users to perform routine and non-routine maintenance without stopping applications through hot-swapping of processors, memory, and I/O. Virtual Iron helps users deliver high availability in a more efficient manner, increase business-critical application uptime, and build a variety of high availability scenarios with far less hardware.

Multi-Tenant Hosting

Companies in the web hosting business – Software-as-a-Service (SAAS) providers, Application Service Providers (ASPs), or Business Processing Outsourcing organizations – have unique data center requirements because of the complexity and sheer size of their computing environments. To be successful they need to rapidly deliver preconfigured business applications over the internet via a subscription-based model and meet stringent levels of service requirements promised in the outsourcing contract.

Virtual Iron's solution supports an environment where customers can share computing infrastructure (multi-tenant configurations) with complete isolation between operating system and applications. The platform makes data center resources available to all the applications and tenants in the system and thus eliminates overbuying capacity (CPU, memory, I/O) for peak workloads. The efficiency and adaptability of resources enable hosting organization to meet SLAs (Service Level Agreements) more consistently and cost effectively. Most importantly, the Virtual Iron platform enables hosting providers to offer desirable new services to their customers such as capacity on demand for seasonal or peak loads and multi-tier development and test configurations for developing applications for subsequent hosting projects.

J2EE Application Deployment and Management

The popularity of developing in the J2EE environment has resulted in a proliferation of customized, mission-critical J2EE applications. To support these multi-tiered applications, today's data centers contain a large number of disparate, different-sized, single-function servers, each dedicated to running specific components of the distributed application. The result is a J2EE application delivery infrastructure that is saddled with major challenges including under-utilized capacity, expensive hardware infrastructure, and complex management environments. This results in inefficient and inflexible systems and SLAs that are difficult and expensive to meet.

Virtual Iron offers a unique solution to meet the needs of deploying and managing J2EE applications. The Virtual Iron platform allows data center managers to combine all J2EE application servers and equipment into a sharable infrastructure-wide pool that can be shared by multiple J2EE applications. Application servers can run efficiently on virtual servers that are built from dynamic physical resources. The platform enables hardware resources to be shared and dynamically allocated to the application

servers that are not meeting performance requirements, increasing utilization without requiring time consuming provisioning and deployments.

Virtual Iron helps organizations reduce the cost of deploying, operating and managing J2EE applications by improving operating efficiency, reducing capital expenditure, and enabling a flexible and agile J2EE infrastructure. The solution reduces maintenance latency and manual intervention by allowing resources to be automatically provisioned based on policies that monitor response times and throughput. It scales both vertically and horizontally to meet business demands while maximizing utilization of hardware resources via workload management. Simplified provisioning of new equipment streamlines J2EE application development and deployment lifecycle activities.

RETURN ON INVESTMENT

Data Center Virtualization delivers dramatic business benefit through reductions in capital expenditure and operating expense, and increases in business flexibility and agility:

Capital Expenditure Reductions

By obtaining enterprise-class computing with commodity components, users gain the best of both worlds – high-end, enterprise-class benefits at commodity prices. There is no longer a reason to over-provision extensively or purchase expensive, proprietary computers. Users can now scale with commodity computing components incrementally as needed. Also, since users can now build multiple virtual computers with shared components from a reserve pool of capacity, server utilization is significantly greater – 4x to 10x in many cases – meaning companies don't need as much commodity hardware either. Users buy only what they need when they need it, instead of buying spare capacity in advance and having it become obsolete in their data center without ever being used. The capital savings above are further increased when the N+1 failover approach to high availability is used to reduce hardware instead of mirroring (building a secondary redundant server per primary server).

Operating Expense Reductions

Industry analysts report that for every dollar spent on computing equipment, it costs $7-10 to manage them. By combining multiple servers and blades into a larger system, data center virtualization enables administrators to manage fewer computers and lower operating costs. Virtual Iron also includes a management console which allows systems to be upgraded in minutes, eliminating the need for fork-lift computer upgrades, which can take weeks. With less time spent provisioning hardware, and managing OS versions and patches, administrators can spend more time on strategic initiatives.

New application projects are more likely to come in under budget as the server/OS provisioning processes and deployment processes between development, test, staging and production are more automated and streamlined. IT staff spends significant time troubleshooting configuration inconsistencies between servers – wasting days and weeks sometimes. Virtualization on the other hand guarantees environments are identical – reducing the time to test applications and the time to set up production environments.

Agility and Time to Market

Business changes rapidly and often unexpectedly. As organizations and customer needs change, the IT depart-

ment needs to respond quickly. Data Center Virtualization allows businesses to rapidly provision new hardware, reconfigure and redeploy existing systems, and upgrade servers in minute or hours, where it used to take weeks.

Through policy-based management, resource changes can be triggered automatically to manage workloads. In addition to the advantages of lower costs, business can be more responsive and competitive.

THE BENEFITS AND ROI OF DATA CENTER VIRTUALIZATION

Benefit	How Achieved	ROI Facts
Reduce hardware costs	Reduce the number of servers by consolidating underutilized servers. Manage peak loads by sharing capacity.	Analysts estimate 80% of enterprise's total capacity is unused. Save $5k to $20k per server eliminated.
Reduce software costs	The unit cost of Linux is significantly less than other Unix OS's and Windows. Fewer App Server licenses are needed since fewer CPU's are needed to handle spikes.	Save $5k to $20k in OS licenses per enterprise application. Save $10K to $15K in App server license per CPU.
Reduce physical operational costs	Replace old servers with smaller footprints, more reliable systems that are less expensive to upgrade and add capacity to.	Blade systems reduce space and power requirements significantly. Save $5k-10k per year, per server in space, power, backups, monitoring.
Reduce infrastructure management costs	Replace physical with virtual resources and reducing training requirements. Train one resource to manage the homogenous virtual infrastructure instead of training many administrators to manage disparate hardware (software tools manage reconfigurations). Avoid specialized software to manage upgrades, patches, configurations. Reduced number of OSs and systems to manage frees up headcount for other activities.	Less people and time required to maintain physical environment since equipment is installed and cabled upfront and only once. Configuration management software can cost up to $100k. Note: For every dollar spent on computing equipment (hardware), it costs $7-10 per year to operate it (people and software).
Reduce development and test costs	Virtual images are used to automate and streamline development-to-test-to-production build/set-up processes. Configuration consistency between environments is guaranteed reducing time spent troubleshooting.	Reduced complexity and rapid provisioning minimizes QA headcount. Time-to-market improvements expedite application benefits. Example: Fewer configuration issues caused by outdated patches or improperly configured machines can take on average 1 to 3 days to troubleshoot.
Reduce server and application deployment costs	Rapid provisioning of virtual and physical servers.	Typical server rebuilds and deployment of 4 to 16 hours per server can be reduced by 50%-75% to less than 2 hours.
Reduce redundant hardware	Eliminate mirrored hardware by taking an N+ 1 approach to redundancy, reducing the number of backup servers.	Save an average $10k to $50k per server.

CONCLUSION

Data Center Virtualization addresses today's most significant data center challenges – delivering agility, availability, manageability and efficiency. This new class of software is available today and enables business applications to run on virtual infrastructure without modifications while providing simplified management and provisioning of industry standard hardware.

Virtual Iron is the leading software provider of Data Center Virtualization solutions and focused on enterprise-class virtualization that operates at the data center level. While first generation virtualization technologies are limited to working at the single machine level, Virtual Iron manages the aggregation and sharing of many machines and devices including server, storage and network resources.
It enables IT to focus on application management—a higher level of abstraction of the data center than the current generation's hardware-centric view. The software uses centralized policy-based management to automate resource and workload management and deliver "capacity on demand" with high availability built in.

The Virtual Iron environment automates many error-prone, time-intensive, labor-intensive tasks and allow administrators to rapidly provision hardware, replicate configurations, move capacity to handle increased workload, move and deploy software images, upgrade servers without disruptions, and monitor health across dozens of devices from a single centralized interface. In the Virtual Iron environment, any application can run on any machine, or be moved to any other machine without stopping operation, enabling the data center to rapidly respond to changing needs.

IT Executives and managers should begin by exploring the opportunities to apply data center virtualization to:

- Consolidate the current number of physical servers
- Optimize the utilization and management of newly purchased servers
- Define a process for rapidly provisioning servers and OS images
- Define a process for rapidly reconfiguring and redeploying hardware resources and servers
- Define a process for rapidly allocating hardware resources to adjust capacity to handle spikes, peak loads and scheduled workloads
- Define a centralized process for managing virtual infrastructure and underlying hardware resources
- Define a development-to-test-to-production plan based on managing reference software images
- Reduce the hardware required for high availability and failover

IT executives and managers should follow these basic steps and begin implementing data center virtualization today to evolve the data center to a truly dynamic IT infrastructure:

- **Step 1:** Select the applications that will benefit most from running on virtual infrastructure.
- **Step 2:** Leverage inexpensive standardized hardware and software as the building blocks.
- **Step 3:** Group and pool server/storage/network resources for sharing including re-purposed and under-utilized hardware.
- **Step 4:** "Virtualize" all resources for application transparency, simpler management and optimized resource utilization.

Done right, Data Center Virtualization improves manageability, increases agility and maximizes resource utilization – overall reducing the capital expenditures and operational costs of managing data centers. Organizations are better positioned to quickly and cost-effectively respond to business demands and dramatically improve the return on investment of data center resources.

ABOUT VIRTUAL IRON

Virtual Iron Software, Inc. provides enterprise-class data center virtualization and management software solutions that transform the static, hard-wired data center into a more manageable, dynamic pool of shared computing resources. With these solutions, organizations can rapidly respond to changing business demands and dramatically reduce the cost of managing and operating their data center.

The company serves large organizations in the financial services, manufacturing, health-care, government, retail and hosted services. From its beginning, Virtual Iron designed its software to manage enterprise-class data centers, with hundreds of servers, networks and storage elements. Its solutions combine the power of virtualization, automation and dynamic, policy-based resource and workload management to offer unmatched scalability and availability without the need to alter business applications.

For more information, visit www.virtualiron.com or email info@virtualiron.com.