

White Paper:

Is your data center a candidate for Virtualization?

- Determine if your datacenter would benefit from virtualization
- Discover the bottom-line benefits of virtualization, including cost & power savings
- Learn the best practices for implementation
- End server sprawl & enable a highly-efficient, cost-effective & easily managed data center



Background

For over a decade, global information technology users and administrators have faced the seemingly insurmountable challenge of server sprawl. "Server sprawl" can best be summarized as a proliferation of commodity servers that are cheap and easy to buy. Missing from the marketing material on such servers, however, is the fact that such servers are, over the long run, costly and complex to own and maintain. Such servers require major budget and personnel commitments and often sit idle for more hours than they operate. In the light of current economic conditions, "server sprawl" is becoming equated with "budget strain."

However, things are changing.

Over the last few years, large information technology users have predicted an imminent end to server sprawl and its negative effects on budgets, personnel requirements and excessive technology downtime. Companies that follow this line of thought are early adopters of virtualization software for Intel x86. These organizations have been pioneers in virtualization technology. They have successfully scrapped thousands of obsolete or poorly used commodity servers in favor of fewer, optimally configured machines often running multiple virtual machines.

To date, most virtualization deployments have involved larger businesses and/or organizations. They have focused on consolidating physical assets mainly to save money.

Technology researchers at IDC estimate that only 25,000 (less than 10 percent) of the commodity servers shipped in 2007 were virtualized. However, that number is dramatically growing as organizations of varying sizes look beyond consolidation and explore virtualization's potential to accelerate new systems deployment.

IDC experts have forecasted that the virtualization services market will increase from a \$5.5 billion market in 2007 to an estimated \$11.7 billion by 2011. One IDC analyst noted that it would be possible to see annual growth rates in the 40 percent plus range just in the x86 market segment.

Companies and IT technology professionals are striving to determine how their business or enterprise can benefit from virtualization.

A Virtualization Overview

"Virtualization" is far from being a new technology.

Virtualization was introduced by IBM in the 1960s, when the mainframe was king. At that time, it was known as "partitioning" and was intended to allow the development of multiple environments around a single mainframe. Over the following four decades, IBM has continued to innovate around virtualization and has extended the technology from the mainframe (now known as IBM System z) to the IBM System i, IBM System p, IBM System x, IBM BladeCenter and IBM storage solutions.

Simply stated, virtualization involves consolidating a large number of individual small machines (servers, storage devices) on a single system. It eases manageability and allows a more efficient use of system resources by allowing them to be prioritized and/or allocated to workloads needing them the most at any given point in time.

Virtualization provides an ability to simulate the availability of hardware that may not be present in sufficient amount – or even not at all. Virtualization uses available physical servers and storage devices as shared pools to emulate missing physical resources. It helps redistribute system resources and can make the difference between flawless execution and slow response times. At the same time, it can provide control over how – and to what extent – a resource is used by a specific virtual server. The user is largely unaware of the virtualization activity.

Server and/or Storage Virtualization

Server virtualization is formally defined as the masking of server resources (including the number and identity of individual physical servers, processors and operating systems) from server users. A server administrator uses software to divide one physical server into multiple isolated virtual environments. These environments are sometimes called virtual servers, but they are also known as partitions, guests, instances, containers or emulations.

Each virtual server has its own set of virtual hardware on which an operating system and application are loaded. IBM systems with virtualization can prioritize system resources and allocate them on the fly to the virtual servers needing them most at any given time.

Server virtualization can be very useful for companies seeking to significantly reduce or even eliminate server sprawl, utilize existing server resources more efficiently, improve server availability, assist in disaster recovery and centralize server administration. Even more important, server virtualization technologies are at the forefront in helping businesses in their technology deployment and consolidation strategies.

Storage virtualization is an intelligent “layer” or methodology that pools storage from multiple storage devices into a common storage pool. Often part of a storage area network (SAN), virtualized storage appears to be one device to the server-operating systems and can be centrally managed and provisioned from a single view.

The move from direct-attached storage (DAS) to SANs resulted from steadily growing data loads and the obvious need to increase cost-efficient storage capacity while ensuring the storage flexibility needed for future growth. SANs, however, created another layer of complexity involving interoperability issues, as well as the necessity for additional resources and infrastructure changes that could be difficult to implement.

Storage virtualization “masks” SAN complexity by aggregating multiple storage devices into a virtual storage pool and isolating servers from physical storage. Virtualized storage allows: adding a storage device without server/network reconfiguration; removing and/or changing storage-volume definitions and assignments from one storage device to another; aggregating

hard disk drives of different speeds and sizes (as well as from different vendors), and dynamically reallocating storage space as workload or seasonal conditions warrant.

Virtualization and Partitioning

By consolidating a large number of smaller machines on one larger server, virtualization eases information technology manageability and increases the efficiency of overall system resources. It presents such resources in a way that users and applications can easily derive value from them, rather than presenting them in a way dictated by their implementation, location or packaging.

Virtualization may have its roots in local partitioning, but the two technologies are not identical and should not be confused. Although virtualization and logical partitioning are complementary to be sure, and more effective when combined, it is important to understand the difference.

Logical Partitioning provides the ability to divide physical system resources into a distinct number of isolated regions that operate independently of each other. In general, there is a one-to-one relationship between a physical resource and the region or logical partition to which it is assigned, thereby creating the equivalent of a “box within a box.” All the physical pieces behave and perform exactly as they would if no partitioning was present.

Virtualization takes the partitioning concept one step further, in that it provides an ability to stimulate hardware availability that may not be present in sufficient amount – or even at all. Virtualization uses available physical resources as a shared pool to emulate missing physical resources. It is capable of very fine control over how and to what extent a physical resource is used by a specific machine or server.

Candidates for Virtualization Technology

Virtualization allows businesses and organizations of various sizes and orientations to see and manage their technology resources with increased flexibility, and without restrictions imposed by implementation, location or physical packaging. While virtualization was the exclusive province of larger organizations for many years, today’s choices are based as much on technology needs and new systems deployment strategies. The most prevalent virtualization practitioners are those with present or anticipated needs in the following areas.

- **Infrastructure Simplification** – Virtualization can help eliminate infrastructure sprawl through virtual servers and storage running securely across a shared hardware environment. A virtual infrastructure can enable increases in server utilization rates from five to 15 percent to over 70 percent. At the same time, it can help lower management costs through a common management platform and tooling.
- **Rapid Application Deployment** – Virtualization can speed infrastructure provisioning and help developers in application testing and deployment.
- **Business Resiliency** – With virtualization, IT managers can more effectively secure and isolate application workloads and data within servers and storage devices for easier replication and restoration.

- **Virtualized Infrastructure Management** – IBM's Systems Director family offers the right management platform and common tools. IT managers can address configuration, deployment, monitoring and workload management in a consistent and common way across their infrastructures. This contributes to simplifying problem determination, increasing productivity and lowering management costs.

IBM virtualization allows its practitioners to mix and match technologies freely through common management tools for managing distributed heterogeneous resources. This offers capabilities to lower switching costs, add flexibility and freedom of choice, and mask complexity. Not having to manage each computer or storage resource separately – but instead managing them together, virtually – permits significant improvements in utilization and administrative costs.

Virtualization Benefits

While server and storage virtualization allow businesses and organizations more effective control over their infrastructures, the technologies also offer financial and productivity benefits.

- **Open Standards Approach** – Virtualization allows an information technology department to manage multiple but unlike systems, dynamically deploy and optimize information technology resources in real time, and take an open- standards-based approach to infrastructure management.
- **Effective Cost Management** – Virtualization provides common management tools for heterogeneous resources. Not having to manage each computer or resource separately – but managing them together, virtually, from a single point – allows significant improvements in utilization and administration costs.
- **Improved Total Cost of Ownership (TCO)** – Virtualization provides a rapid return on investment (ROI) through decreased management expenses and increased asset utilization. In fact, one globally known IT industry analysis organization, Gartner, has estimated that virtualization can contribute to an overall reduction of 15 to 30 percent in cost of ownership, in addition to any savings that may be achieved through server hardware consolidation.
- **Increased Flexibility** – Virtualization supports the pooling of resources that can be centrally managed through an enterprise hub to better support dynamically changing business requirements. It also enhances an organization's ability to change processing requirements at a moment's notice.
- **Easier Access through Shared Infrastructure** – Virtualization offers a resilient foundation and shared infrastructure that enables better access to infrastructure and information in support of business applications and services oriented architecture (SOA).
- **Improved Storage Administrator Productivity** – Because virtualization makes multiple network-attached storage devices appear as a single device, management can be simplified, and less dedicated resource time needed for the numerous individual subsystems.
- **Better Storage Responsiveness** – Storage capacity and storage devices can be added with little or no network downtime. This helps mission-critical business applications to remain available on a 24x7 basis.

- **Reduced Service Outages** – Virtualization enables storage-management functionality, like advanced copy services, for the entire SAN and not just for individual devices. Backup and restore operations, as well as data migration and hardware/software upgrades, can be effected non-disruptively.
- **Dynamic Resource Allocation** – Virtualization can provide dynamic allocation and management of storage resources either manually or through automated, customizable policies. This means smooth growth in changing and/or responding to workload conditions.

Advantages of the IBM/Mainline Approach to Virtualization

As noted earlier in this paper, the growth of virtualization can best be described as “explosive,” as businesses and organizations find it to be the most practical solution for server sprawl and the most efficient avenue to asset management and new systems deployment. These adopters have discovered that such traditional issues related to systems deployment as hardware costs, space constraints, protracted and often costly systems testing, or simply lack of time and resources – disappear with virtualization.

IBM estimates that it has been instrumental in creating well over 2,000 virtualization environments, and its Storage Area Network (SAN) Volume Controller currently accounts for over 50 percent market share in terms of virtualized storage, compared to all other virtualization appliances. IBM's leading United States Business Partner, Mainline Information Systems, reports that virtualization is a matter of growing interest among its customers and prospects.

Why is Virtualization so Important?

It should come as no surprise that analyses performed by information technology professionals generally lead to the conclusion that virtualization technology can optimize Return on Investment, increase productivity and foster better management of IT assets and resources. However, what makes organizations look to Mainline and IBM as trusted partners when virtualizing their infrastructures? The answer to that question, like the technology itself, is simple and evident: the impressive breadth and quality of IBM Virtualization Tools available through Mainline Information Systems.

Breadth of Virtualization Tools – Whether a particular IT environment is mainframe, UNIX, Microsoft Windows, or Sun Solaris, IBM and Mainline have the expertise and technology professionals to implement virtualization painlessly, without disruption to ongoing workloads or requiring customers to replace existing systems. That means simplification and subsequent management of both the virtual and physical environments.

Rather than just simplifying the physical environment and replacing it with complex virtual devices, IBM and Mainline offer the most effective tools to manage the physical and virtual environments together, through the IBM Systems Director family.

- IBM Systems Director is a tool for platform management across IBM systems.

- It offers common tooling across the virtualized environment, as well as tools uniquely tailored to each particular platform. It allows monitoring system performance and switching seamlessly among platforms without interrupting workflows.
- With the base IBM Director, businesses can view and track the hardware configuration of remote systems in detail, and monitor usage and performance of processors, disks and memory.
- IBM Virtualization Manager, an extension to IBM Director, helps configure and manage virtual environments. It maps physical to logical and integrates with such technologies as VMware and select Xen hypervisors.
- IBM Workload Manager, another IBM Director component, allows monitoring/managing resources that deliver service to workloads across an enterprise. *No competing virtualization tool can claim support for z/OS, AIX, i5/OS, Microsoft Windows and Sun Solaris as managed servers like IBM does.* Workload Manager also works with such multi-tiered applications as data mining, Web Banking, email, B2B inventory management and servers.

An Added "Powerful" Benefit – A 2007 study released by the Lawrence Berkeley National Laboratory revealed that U.S. data centers consumed 45 billion kilowatts of power in 2005 – twice as much as consumed five years earlier. The bill for such power was \$ 2.7 billion. The IBM PowerExecutive, available on all x86 servers, is an intelligent software solution that enables the use of power for processing workloads, and not for devices that are standing by. PowerExecutive allows shutting off power usage when processors are not in use. If a BladeCenter has eight blades in use and six blades idle, PowerExecutive reduces power to the six blades until they are needed again.

A Word or Two About Storage Virtualization Tools

Storage virtualization services, such as volume management, snapshots and replication, can reside at the host, network or storage device level. Traditionally, storage intelligence has been at either the host level, with a software volume manager, or in the RAID controller of a storage device.

With the advent of network-based storage virtualization, this intelligence is being moved onto the network. At the network layer, there are several broad platform categories for delivering storage virtualization services in the storage area network (or SAN) fabric.

- General purpose appliances such as the IBM Storage Area Network Volume Controller (SVC), Falcon Stor IPStor
- Purpose Built Appliances, such as QLogic/Troika Networks
- RAID Controllers, and
- Intelligent Switches

The IBM Storage Area Network (SAN) Volume Controller is the crown jewel in IBM's storage portfolio. It is a fourth generation product that can operate with all storage systems – even those from IBM competitors. The SAN Volume Controller places a layer on top of storage that abstracts physical devices from workload requests. With the IBM SAN Volume Controller, availability of applications can be maintained even if storage is taken down for routine

maintenance or suffers an unscheduled outage. Moreover, the IBM SAN Volume Controller can be used to migrate storage when new applications are being installed. Some of the thousands of companies and/or organizations that have implemented the SAN Volume Controller have experienced payback periods of as short as one week.

The following capabilities are among important new enhancements in SVC Version 4.2.1 replication functions:

- *Incremental FlashCopy* provides an ability to copy only the portions of the source or target virtual disk that have been updated since the Flash Copy was last used. This capability promotes making copies more frequently which, in turn, enables faster recovery when backup is needed.
- *Cascaded Flash Copy* permits initiating a copy from a virtual disk that is the target of another FlashCopy relationship. This provides greater flexibility in using FlashCopy.
- *Dynamically Configurable Replication Services Space* enables configuring up to 256TB of replication services capacity per I/O Group as needed, allocating across FlashCopy, Metro Mirror and Global Mirror.
- *Increased Maximum Storage* from 2PB to 8PB means that SVC Version 4.2.1 supports four times more storage than the previous Version. This allows even larger virtualized storage configurations.

Virtualization Across the IBM Server Portfolio

Over the last several years, technology simplification, consolidation, deployment and expense control have been major areas of focus and investment for businesses of all sizes and types. Complexity has proved to be a major hurdle to alleviating such concerns. Owners and managers of businesses, regardless of size, region or industry, agree on reducing or completely eliminating the complexity permeating IT environments. However, systems management is the largest and most rapidly growing IT cost component. Businesses are under strong pressure to stretch dollars farther while deriving additional value.

Enter Virtualization – and its recent innovations across all IBM system models.

Across the entire IBM product portfolio, virtualization promotes efficient resource management, as well as an ability to dynamically provision server and storage resources according to the user's changing demands and priorities. Following is a brief summary of particular contributions that virtualization is making across individual IBM server model families – and what makes these families different from competing alternatives.

Virtualization on IBM System i – System i and virtualization perfectly complement each other. System i has always relied on virtualization architecture that separates users and applications from the underlying hardware technology. A few years back, virtualization of system resources and dynamic logical partitioning was the first essential building block in the development of utility-centric services. Today, thanks to virtualization, a single System i can run up to four different operating systems, including i5/OS, AIX 5L, Linux, and Windows (via integration with IBM BladeCenter and System x servers) on a single server. *It is the only solution in the world to feature this capability.*

System i virtualization also extends to storage. With a single command, a user can backup and store data on all operating systems, not just i5/OS. Whether it is AIX, Linux or Windows, the operating system no longer requires separate operations and instructions to backup and store data.

The simplicity of IBM System i and virtualization extends to the management tools that function with all the operating systems being used. System i's use is enhanced by such system management tools as IBM Director and System i Navigator, tools that go beyond Director cross-platform management to enable resource allocation on a deeper level.

Virtualization on IBM System p – Having incorporated the latest enhancements to virtualization, System p offerings again represent the most complete virtualization offering for UNIX and Linux. IBM Advanced POWER Virtualization can raise overall system flexibility through technologies that reallocate system resources to where they are needed and tap into additional resources on demand.

Whether it is a single processor in a blade server or a 100 server farm, System p scales easily and enables Java-based applications to be implemented almost instantly in a virtualized environment using IBM WebSphere Extended Deployment (XD). Without requiring intervention by a technician, System p with WebSphere XD running can adapt to a shifting workload or anticipated and unanticipated demand spikes in an LPAR configuration by readjusting the provisioning automatically.

In addition to the base virtualization function that comes with every System p server, two optional virtualized editions are available:

- APV Standard Edition – with the most complete virtualization functionality for UNIX and Linux in the industry, and
- APV Enterprise Edition – exclusively on POWER 6 servers with the ability to move a running partition from one POWER 6 server to another with no application downtime.

Other System p areas of innovation include a redesigned HMC interface, monitoring and management tools from IBM Tivoli, IBM System Director Console and System Plan deployment capability on the HMC and IVM.

Virtualization on IBM System x– IBM System x servers and BladeCenter systems built on IBM X-Architecture technology deliver adaptive performance, simple modularity, efficient power and cooling and proactive management capabilities. For System x servers and BladeCenter systems, virtualization can:

- Help increase server and storage utilization
- Enable a highly available and resilient infrastructure
- Help reduce costs and complexity
- Increase flexibility and reliability

In late 2007, IBM previewed its fourth generation chipset, X4, developed for the x86 market. X4 marks significant advances in performance, availability and processing efficiencies for the

System x line of servers, adding to IBM's X-Architecture portfolio of innovation for x86 servers. A new system (System x3950 M2) will be ready for virtualization right out of the box and will eliminate software setup and installation time. An internal USB interface will accommodate chip-based or embedded virtualization software preloaded on a 4GB USB flash storage device.

IBM is currently the market leader in high-end x86 computing. With continued investment and innovation in x86 virtualization capabilities, IBM is positioned to help users optimize their data centers for growth into the next decade.

Virtualization on IBM BladeCenter Systems—IBM's BladeCenter design fits perfectly with a comprehensive vision of virtualization as a broad continuum of logical resources. Virtualization can be used to create multiple virtual machines on a blade or to consolidate multiple blades as a single server, giving users the flexibility to support a wide range of critical business services. The JS21 blades, which are based on PowerPC 970MP processors, offer native virtualization via IBM Advanced POWER Virtualization. With Advanced POWER Virtualization enabled, *a dual-core JS21 blade delivers more virtual partitions than any other single blade on the market.* BladeCenter also supports the use of VMware, Microsoft Virtual Server and Linux distributions (Xen) on the IBM line of x86 blades.

The value of a virtualized infrastructure significantly increases when virtualized storage and I/O are also present. IBM's *Virtual Fabric Architecture for BladeCenter* addresses this issue. Virtualized servers, in many cases, will drive a requirement for more aggregate I/O bandwidth. As part of Virtual Fabric Architecture, IBM offers its MultiSwitch Interface Module, which enables up to eight separate paths to each blade. In addition, InfiniBand (IB) bridges provide hardware virtualization of both Ethernet and Fibre Channel traffic over a single IB fabric.

Virtualization on IBM System z – For decades, IBM users in all industry sectors – as well as IBM itself – have employed System z mainframe virtualization technology as a trusted, reliable, security-rich and robust platform for multi-user computing and for hosting multiple virtual servers. System z virtualization technology helps maintain the integrity of the virtual machine environment while still providing a hosting platform that addresses identity, access, threat, privacy and audit management.

Thanks to System z virtualization, rapid server deployment and provisioning can enable new virtual servers in real time. The System z operating system, z/VM, supports multiple virtual servers on a single hardware platform that can provide quick response to new opportunities and fluctuating market needs. This means that with virtualization, System z and its powerful operating system enables launching new products and services without planning, purchasing, installing and configuring new hardware and software. With support for Linux, z/OS, z/OSe, VSE/ESA and TPF, z/VM provides an option to develop and deploy new products and services in a variety of environments. In short, a single System z mainframe can scale up to millions of transactions per day, or scale out to manage tens to hundreds of virtual servers. It can also dynamically redistribute system resources to autonomously manage varying server demands rapidly – often in just minutes.

A System z feature known as HiperSockets gives virtual servers the ability to communicate at near-memory speed. The feature offers several important advantages. On the hardware side, greater efficiency eliminates much of the latency often associated with external physical networks. HiperSockets also contributes to cost savings by reducing the amount of cabling, routers, switches and hubs that would otherwise be required if physical servers, rather than virtual ones, were connected via an external network. Reducing physical components is one of the first steps towards infrastructure simplification, which can translate to reductions in maintenance and staffing required for systems operation. HiperSockets also provides a security advantage, since inter-server communication is contained within the System z server, eliminating exposures which may arise when separate physical servers communicate with each other.

The Future of Virtualization

As it has historically done across its entire portfolio of hardware, software, services and storage devices, IBM will continue to invest and innovate in virtualization technology.

There is no question that System i virtualization will become even simpler with the release of IBM's flagship integrated operating system, i5/OS in 2008. The new i5/OS Version 6 will carry a host of new features, including enhanced security, Web services and virtualization capabilities.

One such enhancement will expand i5/OS's capability to virtualize storage for Linux or AIX partitions, without requiring the addition of a new disk adapter and disk drives for each logical partition. This will enable storage to be consolidated in one place that is easy to manage.

In i5/OS V6R1, this capability will expand so that the storage in i5/OS partitions can be virtualized, again without the need of a disk adapter or drives from another i5/OS partition or from a Virtual I/O Server partition. This ability to virtualize i5/OS storage to other partitions has been unequivocally endorsed by large customers, because it will make it easier to flexibly test and deploy new i5/OS applications.

V6R1 of i5/OS will also leverage the IBM virtualization management tool, IBM Systems Director, for better management of i5/OS and heterogeneous servers. In this instance, IBM Systems Director will use a simple Web-based management interface to manage i5/OS and such other operating systems as Linux, Windows and AIX on multiple servers.

The newest System i will enhance opportunities for data centers that have been constrained by budget, space, cooling power or administrative support. Through its storage virtualization, the i5/OS platform can deliver excellent performance for multiple applications, maximize the utilization of storage resources and reduce storage management expenses commonly associated with server farms.

Bottom line, i5/OS, and the new System i570 with a POWER6 processor, will extend virtualization capabilities in directions where users have indicated they want to go. It means simplicity, a flexible IT environment and consolidation. Together, they add up to a more productive and cost-effective information technology environment.

Conclusion: Virtually Infinite Technology Possibilities

Limited or reduced budgets, fewer human resources, increasing administrative expenses, shorter development time, increasing pressures to “do more with less” – all of these factors challenge IT departments. They are also the reasons why more and more IT analysts recommend virtualization technology as a cost effective and efficient way to improve technology utilization rates, increase server flexibility, handle growing storage demands and control IT spending.

As explained in this paper, virtualization technology is a way to pool IT resources while masking the physical attributes and boundaries of the resources from users. While originally developed for the IBM mainframe, virtualization today is the subject of intense focus within non-mainframe and network storage environments.

Such renewed interest in virtualization is not purely due to analyst recommendations or competitive developments. When listing key business objectives, many customers have stated that they need business process simplification, as well as the ability to respond to market opportunities more quickly. Virtualization technology incorporates functions that address these challenges. Virtualization is being used by IT leaders in a variety of industries to address global economic challenges and move business forward in this on demand global business world.

How can Virtualization help your business? Mainline, IBM and VMware work together to deliver advanced virtualization programs and processes that will help you respond to new or critical customer requirements rapidly, sometimes within minutes, giving you a competitive business edge. It may provide you an ability to surpass customer and/or supplier response time expectations, thereby helping you meet your service level agreements. Virtualization may even help you please your management and shareholders when they find you have successfully deployed new workloads while meeting current workload challenges – and doing so without additional spending.

Mainline, VMware and IBM are strong business partners with a long-standing commitment to open standards. IBM has decades of innovation built upon a customer-centric approach to technology advancement. VMware is the leader in virtualization software solutions. As an IBM Premier Business Partner and the first VMware National Premier Partner, Mainline has the critical experience and recognized industry experts to deliver your comprehensive virtualization solution encompassing server, storage and desktops.

No one else matches Mainline, IBM and VMware’s depth and breadth of experience in virtualization. The results Mainline achieves comes from years of experience in listening to their customers, understanding their needs and implementing the best solution to meet their requirements. There are no better partners than Mainline, VMware and IBM to deliver your virtualization solution.



Authors Biography

This whitepaper is a result of the collaborative work effort of Mainline Solution Architects and Systems Engineers to provide you with a high-level overview of the components of Enterprise Virtualization solutions.

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