Advisory

The Virtualization Multiplier

Executive Summary

In this *Advisory*, Clabby Analytics (that's me) examines trends in scale-out system designs, particularly IBM's BladeCenter solutions — and the critical impact that virtualization is having on enhancing their overall utilization, management and operations.

The key messages in this *Advisory* are:

- Efficiencies in the design of blade systems are driving major changes in information technology (IT) buying patterns. IT buyers are moving away from highly distributed, under-provisioned rack server infrastructures into energy-efficient, consolidated blade server environments. I believe that expanding interest in blade solutions like IBM's BladeCenter solutions reflects this trend.
- As IT managers deploy blade systems they are finding that the use of hardware- and software-based virtualization has a "multiplying effect" — leading to greatly improved system utilization rates, lower management expenses, reduced acquisition and deployment costs. At the same time, these technologies can help simplify IT infrastructure, improve availability, and enhance system flexibility, making it easier to handle dynamically changing workloads.
- While virtualization can be a powerful "multiplier" there are major differences in the maturity and capabilities of various vendors' offerings. Hypervisor features and functionalities, micro-partitioning, virtual I/O [input/output], and integrated, automated provisioning are just a few of many comparison points that highlight these differences.

With these considerations in mind, I conclude that IT strategic planners should:

1. Actively and aggressively dump under-provisioned rack servers whenever and wherever possible in favor of blade solutions such as IBM's BladeCenter (due to the energy and operational efficiencies of those designs);
2. Study competing blade products closely before committing to a particular vendor's platform. The solution you choose should meet current business needs but also be capable of supporting future plans;
3. Pay close attention to the differences between available virtualization offerings. When choosing a virtualization vendor, consider: 1) which approach to virtualization best suits your enterprise requirements; and, 2) the features and maturity of each vendor's virtualization management capabilities;
4. After making your choice, virtualize newly deployed scale-out systems as soon as possible in order to reap maximum efficiencies and cost benefits.

The Death of Highly Distributed Systems

A major shift is underway in the enterprise computing marketplace as IT buyers move away from under-provisioned, highly distributed rack server environments, and move toward consolidated, integrated blade server architectures. The major drivers of this shift are the notable efficiencies of blade designs *in combination with the use of virtualization technologies*.

The Trouble with Highly Distributed Server Designs

Highly distributed rack-mountable server systems are notoriously inefficient due to inherent design flaws that include:

- Severe under-provisioning. Conventional rack servers typically operate at 20% utilization or less, requiring to build in – and support - excess headroom to deal with peak workload requirements.
- Individual rack servers require individual power supplies (which often lose about 25% of the voltage they consume) and cooling fans. Systems designed for high-availability typically include dual power supplies and fans. The result? Dozens, hundreds, or thousands of power supplies and fans in highly distributed rack environments can waste one heck of a lot of energy.
- Many rack servers require individual NICs (network interface cards) to communicate with other servers. And these NICs need to be linked to often expensive switching equipment, resulting in a complex "spaghetti bowl" of cables typical in these environments. This cabling mess needs to be reduced.
- Rack-mountable servers are bulky in aggregate — rack cabinets take up considerable space due to dis-integrated designs, a problem that expands as rack-based environments grow.
- Management of physically distributed servers is more complex than managing a group of co-located integrated systems, particularly in rapidly or constantly growing IT environments.

The Remedy: Consolidated Blade Systems

On the other hand, consolidated blade environments deliver significantly more processing power in denser, more efficient designs. Consider these architectural advantages:

- Most blade server architectures make use of integrated network backplanes, eliminating the need for expensive switching equipment and complex cabling such as that required for NICs;
- Some innovative blade offerings use highly efficient and shared power supplies along with shared cooling fans. This significantly reduces AC/DC power conversion inefficiencies, associated power draw and cooling costs; and,
- Smaller system footprints and lower power requirements mean that blade systems generate less heat. Accordingly, it costs less to cool consolidated blade server environments than inefficient, distributed rack systems.

Scale-out blade designs deliver more processing power in denser footprints as compared with highly-distributed rack designs. Further, blades are far more energy efficient than distributed rack architectures —

and, due to internal networking backplanes, these designs are significantly less expensive to acquire and deploy than distributed rack servers.

IBM's BladeCenter Design Advantages

Not all scale-out systems are equal. Research analysts are allowed to "take sides" provided that there is sound research behind that analyst's recommendations. And in this case, my research shows that IBM has several distinct competitive advantages in both its rack-mountable and blade system design, as well as in virtualization management. Allow me to explain…

From a scale-out perspective, IT buyers can choose either IBM's BladeCenter systems or System x racks. The primary differences between the two are in size/density, available memory and internal storage, and I/O virtualization capabilities. If an application requires a lot of memory, benefits from a goodly amount of internal storage — and if density and power consumption characteristics are minimal considerations — IBM's System x rack-mount servers can be a good choice. But if density, power consumption characteristics, and highly-integrated infrastructure management are the dominant buying criteria — then IBM's BladeCenter should be the first offering a business considers.

In the blade space, *Clabby Analytics* has written extensively about the competitive advantages of IBM's BladeCenter solutions and design (go to the "Archive" section of www.ClabbyAnalytics.com for free access to these in-depth reports).

These advantages include:

- An architectural approach that enables the sum of the processors and memory in a given chassis (in the VM solution) to appear as one large, self-contained resource;
- A highly flexible, holistic architecture that allows customers to easily configure BladeCenter systems to address and meet their critical business needs;
- Superior design that allows heat to dissipate more efficiently away from core memory modules (a huge reliability/availability design advantage over other vendors' blade implementations);
- Virtual I/O capabilities via IBM's Open Fabric, a communications framework that is designed to help customers reduce complexity and manage risk. Open Fabric is integrated across all LAN and SAN switches and chassis and supports common Ethernet, FibreChannel and Infiniband protocols
- Simplified I/O management with IBM's Open Fabric Manager (OFM). Located in the Advanced Management Module, OFM allows system administrators to save valuable time and effort by pre-assigning MAC and WWN addresses for up to 100 BladeCenter chasses and 1400 new and existing blades.
- Support for common Cisco, BNT (Nortel), Brocade (McDATA), and QLogic fabrics as well as the server connectivity modules and the pass-thru modules. As a result, customers can take full advantage of the ease of deployment I/O virtualization provides without moving to "special" or proprietary switches.
- Using OFM, IT staff can also create and initiate action plans for automated (inter- and intra- chassis) failovers and other scenarios, enhancing disaster recovery and workload balancing efforts;

- A range of blade-based offerings including IBM's Virtual Client Solution, which allows businesses to simplify desktop systems management and application deployment while enhancing security and availability;
- The ability to leverage IBM's SAN Volume Controller (SVC) -- a single point of control for disparate, heterogeneous storage resources – to improve business application availability and resource utilization
- Blade.org, a rich ecosystem of hardware and software developer partners whose solutions help IBM get innovative new blade products and features to market more quickly than competitors;
- External sourcing of key system components such as network switches, which results in a broad and deep set of networking fabrics available to BladeCenter customers. This contrasts with other blade vendors that prefer to build and lock users into their own more limited proprietary switch/fabric solutions); and,
- Highly-integrated management facilities provide a single point of control, allowing BladeCenter systems, networks, and storage to be centrally managed (via IBM Director and Virtualization Manager); workloads to be balanced and automatically provisioned (with Tivoli Provisioning Manager).

Though condensed, this overview articulates why *Clabby Analytics* considers IBM's BladeCenter to be the most innovative and effective blade system solution available.

The Virtualization Multiplier

The efficiencies and cost savings delivered by scale-out architectures are only half of a bigger picture. As IT managers deploy modern blade and rack systems they find that virtualization technologies can help increase system utilization rates, decrease acquisition costs and reduce operating expenses. *In effect, virtualization multiplies the efficiencies and benefits of moving to modern scale-out designs.*

What Is Virtualization?

In short, virtualization simply combines physical computing resources into a common, logical (virtual) pool. By doing so, previously unused or underutilized resources in a given systems, storage, network or application pool can be discovered and exploited by applications seeking to execute workloads. There are many types of virtualization — each offering a variety of benefits.

For the purposes of this report, I will focus on systems and application virtualization technologies related to scale-out blade architectures.

> ***Virtualization is all about the pooling of resources. Systems virtualization creates pools of computing resources known as "virtual machines". Applications can readily be assigned to these virtual machines — enabling administrators to make far better use of the available computing power than is typical in distributed computing environments. Accordingly, system utilization rates skyrocket, manageability is improved through centralized management of denser systems, and operating costs are lowered.***

Deploying a Virtualized Environment

There are essentially three steps involved in deploying a virtualized scale-out blade environment. These steps are:

1) Choose a platform;

2) Choose a virtualization technology; and,
3) Choose an infrastructure management approach.

Step 1: Choosing a Platform

Both application characteristics and hardware considerations influence which platform an organization should choose. For instance, Windows and Linux applications require minimal memory (usually in the 2-6 gigabyte range), allowing them to be supported by most x86-based blade and rack-based platforms. However, some blade solutions also support RISC-based server options. For example, IBM's BladeCenter offers IBM's POWER-based options supporting IBM's AIX, i5/OS, Linux and Novell Netware, in addition to a wide range of Intel- and AMD-based x86/x64 blades supporting Windows Linux and Sun's Solaris on x86.

Additionally, companies should consider other blade platform variables and comparison points including:

- Processing power (dictated by number of cores per system);
- Density (number of servers per system);
- Memory requirements;
- Energy efficiency;
- Cost per virtual machine;
- Infrastructure consolidation;
- Ability to virtualize input/output;
- Storage characteristics; and,
- PCI-x and PCI-E support requirements.

Step 2: Choosing a Virtualization Approach

There are several approaches to server virtualization including emulation, native, hardware-enabled, partial, paravirtualization, operating system-level, and application virtualization. The most common approach to virtualization, however, is to use a "hypervisor" - a layer of software that manages the interaction of multiple operating system instances with the underlying hardware that is being virtualized - to manage OS/hardware interaction.

> ***After choosing the appropriate hardware platform, the next logical step is to evaluate the various virtualization approaches.***

Note that some hypervisors are *hardware specific*. This is particularly the case in enterprise-class server architectures so enterprises that run IBM's POWER-based servers or System z mainframes, Sun's UltraSPARC solutions or HP's Itanium products should use the hypervisors specifically written for those respective microprocessor environments. Enterprises that run x86- Intel or AMD based servers common to scale-out environments, however, have numerous software-based hypervisor and associated management choices. These include VMware's market leading ESX Server and Virtual Infrastructure platforms, solutions leveraging the Open Source Xen hypervisor such as Virtual Iron's Enterprise Edition and Citrix's XenSource products, and Microsoft's Virtual

Server (and Hyper-V after it becomes available later in 2008). A growing number of vendors including Red Hat and Novell also offer virtualization technologies designed for and integrated into their products. IBM's BladeCenter supports most common x86-based virtualization solutions as along with IBM's homegrown Power VM technology.

Also worthy of note, some vendors are embedding virtualization features directly into x86 hardware offerings, streamlining related solutions and relieving general purpose microprocessors from having to spend cycles managing virtualization processing. The new IBM BladeCenter HS21 XM with VMware ESX Server 3i, a joint offering by IBM and VMware, is a prime example of this approach. The new solution integrates VMware's ESX Server 3i, a system-independent, thin (32MB) hypervisor, into a USB-based internal flash drive containing optimal memory and I/O placed directly onto the blade. By making the hypervisor an essential hardware component, the HS21 XM allows users to initialize virtualization within minutes and also enjoy greatly reduced risk of virtual server downtime. In addition, BladeCenter HS21 XM with VMware ESX Server 3i can be integrated, tested and certified at the factory, saving customers deployment time and effort and easing the transition to next generation virtualization.

Step 3: Choose How to Manage Virtualized Systems

In the x86-based scale-out world, most every virtualization vendor sells a management stack aimed at managing its own specific hypervisor solution. This is significantly different from the UNIX realm, where systems choice dictates what hypervisor and management stacks are appropriate to these environments. But some systems vendors also have broader management software offerings that support sophisticated management features. For example, IBM Director, IBM Virtualization Manager, and Tivoli Provisioning Manager can all enhance virtualization functionality in the company's BladeCenter systems.

> ***IT buyers need to understand that the goal of software vendors in the virtualization world is not to sell hypervisors — the goal is to sell the associated management stack. This is the reason why choosing a virtualization vendor based on the strength of that vendor's management stack is so important.***

As IT buyers evaluate the management offerings of virtualization vendors, *Clabby Analytics* recommends that particularly close attention be paid to a given vendor's ability to automate redundant tasks such as virtualizing I/O or automating the provisioning [build-up or tear-down] of guest operating environments. The biggest paybacks in virtualization in terms of operational savings are found in enhanced systems management and automated tools that help reduce management costs.

Why Clabby Analytics Particularly Likes IBM's Approach to Virtualization

As organizations adopt IBM's BladeCenter solutions, they derive a range of benefits including lower acquisition and operating costs. In addition, by virtualizing BladeCenter systems, IT executives find they can also:

- *Reduce systems management costs* - It is easier to manage highly-integrated blade environments than to manage myriad distributed servers;
- *Enhance systems utilization* - Virtualization enables unused resources to be easily located and exploited — thus improving overall server utilization;
- *Improve systems availability* - Virtual servers can be easily configured to back-up or provide failover service, thus strengthening disaster recovery processes;

- *Lower operating costs* - Consolidating servers and applications on blades notably reduces costs related to power/energy consumption and facilities support;
- *Reduce deployment/installation costs* - BladeCenter's integrated design eliminates much of the labor required for networking and other tasks;
- *Simplify virtualization management* - With IBM Virtualization Manager – a no charge IBM Director extension in IBM POWER, VMware, and Xen environments
- *More easily build-up or tear-down virtual servers* - In order to conduct testing/quality assurance on existing, production servers; and,
- *Benefit from virtualization end-to-end* – By leveraging innovative IBM solutions in every stage of the IT infrastructure; client, server, I/O, networking and storage

Highly-integrated management facilities allow for systems, networks, and storage to be managed (IBM Director/Virtualization Manager); and for workloads to be automatically provisioned (Tivoli Provisioning Manager).

Scale-up Benefits in a Scale-Out Blade Package

IBM's BladeCenter is merely one example of the company's long history of systems and virtualization innovation. IBM invented systems virtualization over forty-years ago — on the company's mainframe platform — and offers the most sophisticated system virtualization environment in the world available in its current System z offerings. IBM advances in virtualization and virtualization management have since rolled-down (cascade) into other IBM server architectures including System p, System i, System x and BladeCenter.

As an example of the level of advanced virtualization capabilities available in IBM's scale-up systems designs, consider that IBM's System p and System i servers allow a single POWER6 microprocessor to be micro-partitioned with up to ten virtual threads being processed simultaneously. Further, System p and i solutions allow for active migration of workloads — the ability to move workloads transparently to other systems. Imagine the cost benefits of moving reduced nighttime workloads onto one or a handful of servers and powering down the rest of a datacenter. This is one of the advanced virtualization benefits provided by IBM's scale-up Power systems

What does this have to do with BladeCenter's scale-out architecture? IBM recently announced a number of advances for its JS22 POWER6 processor-based blades including its new PowerVM software (formerly known as Advanced POWER Virtualization or APV) which includes a free feature allowing Power-based servers to run Linux x86 binary applications unmodified without recompilation. This is in addition to the JS22's support of IBM's AIX (UNIX), i5/OS, and Linux on POWER operating environments and solutions. As a result, IBM's BladeCenter supports the widest and deepest choice of processors, operating systems, applications, networking options, and virtualization technologies of any vendor's blade solutions, delivering notable scale-up value in a highly flexible scale-out solution.

For these reasons, Clabby Analytics believes that IBM's BladeCenter and its associated solutions provide a better design than the blade chassis and products offered by other systems vendors.

Summary Observations

Moving from towered systems to highly-integrated scale-out system designs is a wise idea from an environmental, operational, and management perspective. Organizations can save vast amounts of money and valuable IT staff time by consolidating inefficient distributed tower systems onto scale-out solutions such as IBM's BladeCenter. But moving to these new systems architectures provides only half of the full value that enterprises can gain by enhancing computing efficiency. The deployment of virtualization technologies provides a "multiplier" effect that notably expands savings in energy use, in systems utilization, and in operating expenses.

To maximize return on investment in these new environments, IT executives need to understand the central role that virtualization plays in improving overall systems efficiency and greatly reducing operating costs. To do this, IT executives need to examine the comparative differences between various blade offerings because of the significant impact these features have on deployment, networking, and management costs — as well as on system integrity, reliability, and availability. By choosing highly innovative and adaptable solutions like IBM's BladeCenter, organizations can help ensure that their critical business IT needs will be met today and in the future.

Parting advice: IT buyers should move away from distributed tower servers. Adopt the appropriate scale-out blade architectures to support given workloads. Also, understand that the level of virtualization sophistication differs between vendors — so build your strategic virtualization plan accordingly

Clabby Analytics
http://www.clabbyanalytics.com
Telephone: 001 (207) 846-0498

Clabby Analytics is an independent technology research and analysis organization that specializes in information infrastructure and business process integration/management. Other research and analysis conducted by Clabby Analytics can be found at: www.valleyviewventures.com.