



IBM Introduces More-Efficient x86 Servers — Improving Virtualization, Energy, Lowering TCO

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Management Summary

Every home handyman or professional mechanic knows that you need the “right” tool to do the job. Obviously, this requires making an initial investment to ensure that you have a complete set of tools: slotted and Phillips-head screwdrivers, open-end and box-end wrenches, standard and metric, to be sure that you can handle any requirement, as well as a set of hex keys or Allen wrenches, in addition to any number of power tools. Sure, you can use the proverbial “adjustable” wrench that can be sized to fit any purpose (*one-size-fits-all, just not very well*). However, this type of tool may slip, or even strip the threads of the hard-to-find expensive bolt, causing you to make an unexpected investment in both time and money. As an old familiar saying goes, “you can pay me now, or pay me later.” Unfortunately, “pay me later” often turns out to be a larger figure!

Having the right set of tools is even more important in the data center of any enterprise. As we have learned over the past few years, the total cost of ownership (TCO) of an information technology (IT) infrastructure entails more than simply the acquisition cost. Data centers around the world have become choked with inefficient and poorly managed servers, storage, and administrative resources. In many cases, servers are only being utilized at 15% to 20% of their capability. Unfortunately, the enterprise must account for 100% of the electrical power required to run these resources and cool the data center, as well as 100% of the floor space occupied by an under-utilized IT infrastructure. In order to reduce the TCO of the data center, many enterprises have engaged in programs to consolidate their application set on the latest multi-socket, multi-core processors. **The goal is to virtualize multiple applications on a single platform to utilize available processing resources more fully.** Some of these applications are CPU-intensive; others are I/O-intensive. Each requires a specific configuration (tool set) in terms of the number of processors, the amount of memory, the number of I/O ports, etc.

As with the mechanic, one server size does not necessarily fit all application environments. One enterprise may be focusing on a rack or blade environment for their data center, a different architecture for their branch offices, and a tower format for their remote requirements, all of them scalable to a different degree. CPU-intensive applications may be looking for multi-socket nodes, while virtualization environments require greater memory scalability. In order to simplify the infrastructure, the organization needs to find a vendor that not only offers a wide variety of server options, but also offers a common interface. IBM has now announced a wide variety of servers based upon Intel’s newest architecture, the *Xeon 5600 Series Processor*, extending their broad support for Xeon. To learn more about how IBM’s new servers can reduce the TCO of your data center with scalable, energy-efficient options that can consolidate and virtualize your environment, please read on.

IN THIS ISSUE

➤ Data Center Issues	2
➤ The Intel Xeon 5600 Series Processor	3
➤ IBM’s System x Family	4
➤ Conclusion	6

Data Center Issues

The data center staff in every enterprise, large or small, faces the same problems on a daily basis – trying to manage a constantly growing network of under-utilized servers while, at the same time, trying to find a home for business data that is doubling in size every 12 to 15 months. Unfortunately, the pain does not stop with just these physical resources! The TCO for the IT infrastructure also includes costs for *communication, floor space, energy* to drive the architecture while at the same time cool the data center environment, and for the *personnel* necessary to administer this mission- and business-critical network.

An overwhelmed CIO faces the daunting task of removing data center complexity to provide the enterprise with an efficient IT infrastructure while maintaining, or improving, performance *while remaining within an ever-shrinking budget*. Due to the downturn in the economy and the ensuing budget freezes, almost 40% of data centers operations still operate with an older, single-core, legacy x86 servers, while another 40% are operating with a dual-core environment that is almost as old.¹ Unfortunately, these platforms consume 100% of the IT infrastructure's energy needs, while underutilizing IT resources, driving up the TCO even further. When the CIOs of these data centers take a step back to see what hurdles need to be overcome in order to lower the TCO of the IT infrastructure, certain issues stick out as pain points as sharp as the thorns on a rose.

One of the sharpest thorns is the utilization rate for mission- and business-critical servers. Many enterprises run applications on older open system x86 servers, in a complex, scale-out architecture. The IT staff typically deploys a single application on each of these servers and, unfortunately, probably realizes less than 15% utilization of the compute power of these platforms, in some cases, even less. **As floor space and energy become scarce commodities, wasting 85% of any resource no longer can be tolerated.**

Other thorns, such as software licensing and expiring warranties, also weigh heavily on that budget. In order to make better use of the data center and all of its resources, and to reduce the cost of operations and management, **the typical IT staff now consolidates many applications**

onto multi-socket servers with high core-count – tower, rack, or in a bladed environment – with direct-connect or internal storage devices or a networked storage architecture, whether SAN or NAS. These consolidated servers can be virtualized, some adding complexity, to utilize their resources more fully, using a hypervisor from companies such as VMware, Citrix, or Microsoft. In this way, multiple applications can share computing resources, energy, and floor space in order to make better utilization of the data center. This enables a smaller IT staff to shift the alignment of resources as business priorities change, enabling the IT staff to lower operational expenditures.

Consolidation and virtualization also enable the IT staff to make better use of the energy needed to drive the platforms and cool the data center environment². This requires the availability of an intelligent systems management that can manage the amount of energy being consumed, precisely, not only by each processor, but also by each core in the server. If the IT staff can control, perhaps even reduce, the amount of energy being consumed, they then may avoid the acquisition of that \$5M server – **the one that forces the enterprise to build a new data center!**

In many cases, however, **virtualizing the server environment requires the data center to dedicate more physical resources to the server, if they are available.** This includes additional memory to support multiple applications on a single shared resource. It also includes increased disk activity in the array to allow multiple applications to communicate with shared storage. However, the I/O ports available on many legacy servers are not sufficient to handle the throughput of a virtualized environment. Not only does the server require increased bandwidth, but each application also needs its own communication path for network connections, necessitating more physical ports or a higher bandwidth.

In order to reduce the TCO of the data center significantly, the IT staff must take advantage of every tool at its disposal. **Consolidation and virtualization of servers and storage can provide the enterprise with the tools that they need to find the right balance between the simplification and the optimization of the IT**

¹ Intel presentation dated March 16, 2010, by Shannon Poulin, Director of Xeon Marketing.

² See the issue of *Clipper Notes* dated November 24, 2008, entitled *Capping Energy Demand in the Data Center – "It's Not Easy Being Green!"*, and available at <http://www.clipper.com/research/TCG2008061.pdf>.

infrastructure.³ The mid-sized (SMB) data center may be focusing on simplifying the environment so that a less experienced IT staff can manage it. On the other hand, a large enterprise with hundreds (thousands) of virtual servers and petabytes of storage may be seeking to optimize their architecture. In either case, the final result will not be at either extreme of this sliding scale. The SMB may not be able to afford to run an underutilized architecture, while the larger enterprise will seek to simplify a fully consolidated and virtualized environment in order to control its TCO, which may now be more weighted by staff costs. **Both need to find the right balance point to incorporate simplicity and optimization into their framework.**

With the announcement by Intel of the *Xeon 5600 Series Processor*, formerly called *Westmere EP*, IBM has the right tool to extend their x86 capability. However, overall performance of the System x cannot be measured by processor performance alone. IBM has surrounded the CPU with other tools, superior memory expansion, increased storage capacity, increased RAID efficiency, and improved energy efficiency in a variety of formats.

Intel's Xeon 5600 Processor

For those who believe that your enterprise budget cannot afford to upgrade your infrastructure to a more modern architecture, think again: the fact is that you cannot afford not to. The monthly costs for energy consumption, software licensing, and maintenance for enterprise servers alone are drowning your IT budget in red ink. Replacing your existing five-year-old single-core environment with one based upon Intel's Xeon 5600 Processor will enable your IT staff to consolidate multiple applications on a single server with a virtualization ratio of up to 15:1, freeing up rack space and saving up to 95% of your energy budget. On this basis alone, the ROI might be as quick as five months. Even if you choose not to consolidate, simply upgrading on a 1:1 basis in order to take advantage of the 15x performance improvement available with the Xeon 5600, the data center would still achieve an 8% reduction in energy consumption.

The 5600 is available in a four-core standard mode, or a six-core advanced mode, providing

even more efficiencies. Using the six-core configuration, the *Xeon 5650*, the data center can achieve about 40% higher performance than with the *Xeon 5640*, with four cores⁴. As a result, the data center would need fewer servers, lowering the acquisition cost, as well as the software licensing costs for the operating system and virtualization software. The 5600 is also available in three low power frequencies, including the *Xeon L5640* six-core processor, to enhance energy efficiency. The L5640 has the same performance level as the *Xeon X5570*, but requires up to 30% less system power.⁴

The Xeon 5600 also comes with an outstanding set of embedded security features to provide a three times increase in the encryption/decryption rate of Advanced Encryption Standard (AES) processes compared to the previous generation. The 5600 has seven new AES instructions to allow the processor to perform hardware-accelerated encryption for faster execution. This helps protect the data center from cyber attacks and assists the enterprise in complying with new regulatory requirements, such as Nevada's Encryption Law for Data Transmission and the Massachusetts Data Protection Law, when deploying secure virtualized solutions.

From a processor standpoint, server performance can be viewed from two different perspectives: the *technical-compute (high-performance, or HPC) environment* and the *mainstream enterprise application environment*. Using technical compute guidelines for measuring high-performance computing, the Xeon 5600 shows outstanding results, even when compared with its predecessor, Intel's *Xeon 5500 Series Processor*. Using *SPECfp* as a barometer of floating point performance, the Xeon 5600 outperforms the Xeon 5500 by 25%.⁵ If your data center is looking for an HPC engine, the Xeon 5600 outperforms the Xeon 5500 by 61%, using *LINPACK* as the measuring stick⁶. Other benchmarks for memory bandwidth, CAD, and financial calculations are as impressive, with the financials benchmark showing a 63% advantage for the new 5600.

With general purpose, mainstream enterprise applications, the Xeon 5600 shows similarly impressive results. Using the *VMmark* benchmark to measure virtualization capability, the 5600 has a 29% edge over the older 5500, as a result of

³ See the issue of *Clipper Notes* dated March 26, 2009, entitled *Feeling Overwhelmed in the Data Center? – Understanding Why*, which is available at <http://www.clipper.com/research/TCG2009014.pdf>.

⁴ From *Intel Xeon 5600 Series Processor Performance Study*, 1Q2010.

⁵ *Ibid.*

⁶ *Ibid.*

higher raw performance (as measured by the *SPECint_rate_base* benchmark⁷), the improved virtualization efficiency gained from Intel's *QPI* interface, and the availability to support the higher DDR3 memory bandwidth and capacity, along with 5600's embedded virtualization command set. The Xeon 5600 also has a 45% advantage in a database environment, using the *TPC-E* benchmark as the basis for comparison. In a Java environment, using *SPECjbb* as the guideline, the 5600 comes in with a 50% edge⁸.

These figures, however, generally reflect the impact of the Xeon 5600 processor on the IT infrastructure, not the combined effect when also considering the server's architecture. To do that, we must look at IBM's latest generation of open systems servers, IBM's *System x M3* family.

IBM's System x Family

Each year, the energy and IT demands being placed upon your enterprise data center continue to grow. It is incumbent upon you to meet these challenges and opportunities while at the same time managing the risks and reducing the cost of your IT infrastructure. While the ancillary costs of running a data center are rising, the cost of acquisition for a new server is, in fact, holding fairly constant, if not decreasing. In order to satisfy these demands, the time may be right to replace your aging infrastructure with a new, energy-efficient System x server from IBM. The only question that you might have is "*Which server platform is right for my IT environment?*"

IBM has announced a wide variety of platforms in support of its M3 generation of Intel servers, including rack, tower, blade, and *iDataPlex* formats. Each of these servers delivers the latest technology and innovation from IBM's labs. **With 50% more cores than their System x M2 servers, M3 servers can deliver a 40% increase in performance, and up to a 60% improvement for HPC environments due to the server-surround innovations that IBM has added to complement the Xeon 5600 CPU.**⁹ With up to 50% higher memory capacity and 60% more internal storage on rack-optimized platforms, IBM can deploy their most price/performance server yet, designed to increase performance per watt and decrease complexity. An energy-efficient design incorporates the function-

ality of *IBM System Director* and *Active Energy Manager*, along with extensive systems management features with remote management.

IBM has complemented the Xeon 5600 with automated processes to manage energy-efficiency, high availability, reliability, and ease of use – enabling the enterprise to invest its IT staff in increased business innovation rather than mundane IT administration. IBM has invested in RAS features to provide the quality necessary to maintain your critical business applications in operation.

Let's take a look at the improvements that can lead to an ROI in as little as three months.

System x Rack-Mount Servers

IBM has introduced two new two-socket rack-mount servers: the *System x3650 M3* and the *System x3550 M3*. Designed to reduce your costs and simplify deployment, they offer best in class reliability and flexibility while maximizing your productivity in meeting your business-critical performance needs. Both systems come with energy-smart features to decrease energy consumption and improve performance per watt. These features include low-wattage, efficient hot-swap power supplies and counter-rotating fans, an altimeter to regulate power, and advanced management tools.

Both servers are configured with Intel Xeon 5600 series processors with the QPI technology and access to memory at up to 1333 MHz. They come with the flexibility for up to 12MB of L3 cache and support for either 192 GB of DDR-3 RDIMMs via 18DIMM slots or 48GB of energy-efficient DDR-3 UDIMMs¹⁰ via 12 DIMM slots, a 50% increase. They also have two integrated network interfaces, two optional Gigabit Ethernet ports, and an integrated 6Gbps RAID adapter for improved performance and throughput, to provide the resilient and high-performance architecture necessary for mission-critical applications, as well as virtualized environments. These systems include IBM's *IMM* (Integrated Management Module) with a comprehensive set of management tools and advanced diagnostics, and the ability to control resources from a single pane of glass. They are easy to deploy, integrate, service, and manage.

IBM System x3650 M3

The System x3650 provides expandability and high performance in a 2U configuration, sup-

⁷ Published by Standard Performance Evaluation Corporation; see <http://www.spec.org/>.

⁸ Intel Xeon 5600 Series Processor Performance Study, *loc. cit.*

⁹ *Ibid.*

¹⁰ 16GB RDIMMs/4GB UDIMMs will be available 2Q10, according to IBM.

porting two six-core CPUs running at 3.33 GHz or two four-core processors at 3.46 GHz. It has four PCIe expansion slots and support for up to 16 2.5" hot-swap SAS or SATA HDDs or SSDs. This provides the data center with up to 8TB¹¹ of hot-swap SAS/SATA storage or up to 800GB of hot-swap SSD capacity. The x3650 M3 achieved the #1 two-socket, single node server result for *SPECpower_ssj2008*.¹²

IBM System x3550 M3

The System x3550 provides expandability and high performance in a 1U configuration, supporting two six-core CPUs running at 3.33 GHz or two four-core processor at 3.46 GHz. It has two PCIe expansion slots and support for up to eight 2.5" hot-swap SAS or SATA HDDs or SSDs. This provides the data center with up to 4TB¹³ of hot-swap SAS/SATA storage or up to 400GB of hot-swap SSD capacity.

System x Tower Servers

IBM has also unveiled two new dual-socket high-performance towers, the IBM *System x3500 M3* and the *System x3400 M3*, with both systems capable of being rack-mounted in a 5U chassis. These towers enable the data center with the flexibility to scale performance, memory, and storage to respond to a changing business environment. Based upon the Intel Xeon 5600, these IBM towers enable the data center with faster processing and an energy-efficient design, along with high availability through mainframe-inspired reliability features and an integrated 6Gb/s RAID interface to help minimize interruptions. The towers can support up to 16TB of storage with a variety of configurations employing hot-swap bays. With the X5600 processors, IBM enables a 40% performance increase over M2 models.

IBM System x3500 M3

The System x3500 is available with Intel Xeon 5600 six- or four-core processors, and has the flexibility to add a second CPU in order to double the productivity. The system supports 12MB of cache per CPU and, with 16 DIMM slots, can support up to 192GB of 1333 MHz, DDR-3 RDIMMs or 48GB of energy-efficient DDR-3 UDIMMs⁹. With no single point of failure, the x3500 can be relied upon to execute mission-critical applications.

The x3500 has six PCIe expansion slots and one standard PCI slot. Additional PCI-X slots

can be configured with the removal of one PCIe slot.

IBM System x3400 M3

The System x3400 is also available with Intel Xeon 5600 six- or four-core processors and has the x3400 has the flexibility to add a second CPU in order to double the productivity. The system supports 12MB of cache per CPU and, with 16 DIMM slots, can support up to 128GB of DDR-3 RDIMM memory or 48GB of UDIMM memory.

The x3400 has five PCIe expansion slots and one standard PCI slot. Additional PCI-X slots can be configured with the removal of one PCIe slot, on a configuration-to-order basis.

System x BladeCenter

IBM has announced two new dual-socket blade servers to take advantage of the extended performance and memory connectivity of the Xeon 5600. The IBM *BladeCenter HS22V* and the *BladeCenter HS22* provide the data center with outstanding performance for virtualization along with unparalleled RAS features and innovative systems management. Both models enable the IT staff to manage growth in a rapidly changing enterprise environment and reduce risk on a proven BladeCenter platform. Both blades are optimized for power and cooling, proving an energy-efficient environment.

Each is configured with a *Broadcom 5709S* onboard NIC with dual Gigabit Ethernet ports with TOE and a common set of systems management tools, including a *Unified Extensible Firmware Interface (UEFI)* and the IMM. Each also includes IBM's *System Director with Active Energy Manager* to manage energy efficiency. They include support for four ports of high-speed I/O or eight ports of virtual I/O using *Virtual Fabric for IBM BladeCenter*.

IBM Blade Center HS22V

Specifically designed for virtualized environments, the HS22V supports a choice of up to two Intel Xeon 5600 or 5500 processors, with a choice of standard, basic, and low voltages. It has 18 DIMM slots to support up to 144GB of DDR3 memory, with up to 12MB of L3 cache. This enables you to consolidate more applications with larger virtual machines per blade. With a pair of 50GB SSDs (RAID-0 or -1 capable¹⁴), the HS22V provides the data center with the reliability it demands when virtualizing mission-critical applications.

¹¹ Up to 9.6TB in June 2010, according to IBM.

¹² See <http://www.intel.com/performance/server/xeon/summary.htm>.

¹³ Up to 4.8TB in June 2010, according to IBM.

¹⁴ RAID-5 with battery-backed cache is optional.

IBM BladeCenter HS22

Designed for versatility, the BladeCenter HS22 provides the flexibility required to satisfy a broad range of workloads, including virtualization and enterprise applications, with outstanding RAS characteristics. **With more performance and energy efficiency, and lower cost, the HS22 provides impressive value for the data center.** It supports up to two Xeon 5600 processors running at 3.06GHz. With 12DIMM slots, the HS22 can support up to 96GB of memory at speeds up to 1333MHz. The HS22 has two hot-swap bays for SAS HDDs or SSDs, with a maximum of 1TB of internal storage.

iDataPlex dx360 M3

The most demanding enterprise applications need the highest computing performance, but the data center often is constrained by space and power/cooling restrictions. The new *iDataPlex dx360 M3* extends the capabilities of *iDataPlex*¹⁵ to more workloads, with increased storage and reliability. The dx360 M3 is easy to manage and delivers outstanding performance in a flexible package, enabling the data center to deploy more performance into the floor space and energy envelope as the previous model.

Configured in a unique half-depth, 2U flex chassis, or a 3U storage chassis, the dx360 M3 supports two Xeon 5600 processors running at 3.06GHz. With up to 12MB of cache and 128 GB of DDR-3 memory installed in 16 DIMM slots, the dx360 can handle the most demanding HPC applications. With expansion capability for five 3.5" drives in a 2U chassis or twelve 3.5" drives in a 3U package, the dx360 M3 has the capacity to handle the storage growth that sometimes accompanies growth in processing requirements, with twice the capacity of the *dx360 M2*¹⁶. Moreover, with 160GB and 320GB SSDs, the dx360 M3 has the high IOPS required to make the most efficient use of the *iDataPlex*'s storage capacity.

iDataPlex also allows interconnect fabric adapters for Ethernet, Fibre Channel, and InfiniBand and RAID-0, -1, -5, -6, -10 via an optional controller. As with the entire System x family, the dx360 M3 comes with IBM's *System Director*, including *Active Energy Manager*.

Conclusion

The heart of IBM's new M3 line of System x servers is Intel's new, high-performance Xeon 5600. This, by itself, does not make it unique, however. By definition, commodity processor-based servers are available from any number of system vendors. We can assume that HP, Dell, and any number of other vendors will have their versions available soon. The differences with the M3 family from IBM are the many ways that it helps the enterprise by reducing data center IT costs.

In order to keep productivity high, IBM has added value to the Xeon 5600 with automated processes to manage energy efficiency, high availability, reliability, and ease of use – enabling the enterprise to invest its IT staff in increased business innovation rather than mundane IT administration. IBM has invested in the quality necessary to maintain your critical business applications in operation.

With a potential server consolidation ratio of up to 20:1 using IBM System x3650 M3 servers versus the previous generation¹⁷, a 60% higher server performance than System x M2, and the advanced virtualization qualities required for the most efficient use of IT resources, IBM has delivered the innovative infrastructure necessary for as quick as a three-month ROI for new System x M3 servers¹⁷. Obviously, this will reduce the TCO for enterprise the data center environment. The question is not whether to upgrade to M3 but what will it cost you not to do so. If your enterprise is looking to increase the performance of the IT infrastructure and reduce the TCO of the data center, IBM's System x M3 may be what you seek.



¹⁵ See **The Clipper Group Navigator** entitled *IBM Lowers Changes Paradigm for "Megaplex" Provisioning*, dated April 25, 2008, and available at <http://www.clipper.com/research/TCG2008024R.pdf>.

¹⁶ The dx360 M3 can store 10TB in a 2U chassis or 24TB of data in the 3U chassis, both with hot-swap HDDs.

¹⁷ Based on IBM's TCO analysis of System x3650 M3 vs. System x346 using IBM Systems Consolidation Evaluation Tool. See <https://roianalyst.alinean.com/stg/>.

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