



## IBM Lowers TCO in the Data Center — Innovation Surrounding Nehalem Scores Big

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### Management Summary

Many products try to be all things to all people; few succeed, many fail. Whenever you see a sign that says *One Size Fits All*, you just know that what it should really be saying is that one size fits all, *just not very well*. If you take a walk around any mall in America, you can see the truth in the latter statement. Young men wearing baggy shorts that are way too big and oversized XXL T-shirts that you know were never tried on for size. You also see young girls walking around in skirts and dresses that are simply too short to be worn outside of a cheerleading class. On the other hand, you have a product such as a Swiss Army Knife, designed to provide a tool for every need. The Swiss Army Knife would be the ideal tool to bring along if you hoped to become the last man standing on “Survivor”. Unfortunately, even the Swiss Army Knife is not the best tool to use if you need to cut down a tree or dig a large hole. You would be better off with a wood axe and a shovel than a tool with a hundred features that you will never use. The right tool for the job is always best!

Finding the right tool for the data center is at least equally important. There are many platforms available to the CIO for deployment, including blade, rack, and tower. The data center can install a proprietary solution designed for one specific application, but is of little use in other environments, or it can implement a commodity solution based upon an x86 architecture that can be used in a variety of deployments. In the recent past, data centers around the globe have chosen to go with an open systems approach, acquiring platforms from any number of vendors, creating a heterogeneous environment of servers deployed with a specific application. This has resulted in a complex environment of under-utilized servers, where the administrative costs spiral upward to support a varied environment. These platforms, typically, are running at about 15 to 20% CPU utilization, wasting resources. In order to lower the total cost of ownership (TCO) of the data center, the CIO has to gain control of the recurring operational costs that are eating away at a diminishing budget. **In an era where the CIO must make every dollar count, the IT staff has to gain control of the issues that are consuming that budget: energy, administration, floor space, and overall complexity.**

In order to do that, the enterprise must spend money to make money; it has to upgrade the existing infrastructure in order to reduce the OpEx that is eroding the bottom line. One arena in which to accomplish that immediately is the server network. With the recent announcement of Intel’s newest microprocessor technology, the *Xeon Processor 5500 Series*, Intel has made available the tools necessary to simplify and optimize the data center. How the leading server vendors utilize the new Xeon processor to consolidate and virtualize the data center environment, reduce power requirements, reclaim valuable floor space, and minimize administrative costs will help you determine how to upgrade. To see how IBM has integrated the new Xeon processor into *System x* to lower TCO and improve performance, please read on.

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## Turmoil in the Data Center

The CIO of every enterprise, large or small, is being overwhelmed by a myriad of issues that all have a serious impact on the bottom line of the enterprise, and, potentially, on the bonus that he/she is expecting at the end of the year. The complexity of the I.T. infrastructure caused by heterogeneous server sprawl and an uncontrollable growth in data storage, along with the underutilization of these data center resources, result in a tremendous waste of these resources and, ultimately, a significant increase in the TCO of data center operations.

The past decade has seen a remarkable shift in the distribution of I.T. dollars. Ten years ago, well over 50% of the I.T. budget was dedicated to server acquisition, with lesser amounts required for server management and for administration, and even less for the energy required for power and cooling. Today, while the dollar value reserved for server acquisition is about the same as ten years ago, the percentage of the I.T. server budget for that has fallen dramatically, down to about 30%. By far the most significant increase, in dollars and percentage, is being dedicated to server management and administration, now about 50% of the budget. In fact, for every dollar being spent on server hardware, another \$.50 is being spent on energy. With no limit seen yet for the costs of energy, this portion of the I.T. budget could continue to rise. In addition, for many data centers, especially those in dense urban areas, there is a limit to the amount of energy available to them. For them, the next server deployed could force the enterprise to build a new data center at a cost of millions of dollars. Unfortunately, a significant portion of the energy used is being wasted, as only 15 to 20% of the processor is being utilized, with the remaining 80% wasted.

In order to create a more dynamic infrastructure with improved performance, the I.T. staff must improve server utilization and reduce administrative overhead. Consolidation and virtualization are two of the strategies that many data centers are implementing in order to **reduce physical server count, improve server utilization, reduce energy demand, reclaim floor space, and reduce administrative headcount while maintaining, or improving, reliability.** A virtualized environment enables the data center to support a dynamic infrastructure that can provide the resources needed to deploy not only today's mission- and business-critical applications, but also to enable the data center staff to manage the

risk associated with deploying tomorrow's applications in a changing economic environment.

However, when you restructure the server architecture from multiple physical platforms to a single virtualized platform with multiple virtual machines, you need an architecture with enough performance to support a variety of applications, along with enough memory for hundreds, or thousands, of users. You also need an architecture that can support an increased communications workload with I/O pipes that can maintain a higher throughput level. **Enterprise CIOs need to deploy an infrastructure that will maximize enterprise ROI, reduce TCO, and lower risk.**

Intel has responded to these requirements with the introduction today of the new *Xeon 5500* to provide the engine with the raw compute power to support the consolidation and virtualization of the data center environment. IBM has then integrated that microprocessor into a family of *System x* servers with the functionality required to support a dynamic infrastructure.

### Intel's Xeon 5500

With the introduction of the *Xeon 5500 Series EP* processor, Intel has taken the *x86 architecture* to a higher plateau. Based upon the *Nehalem* architecture, the 5500 will allow Intel to scale processors from two-to-eight cores in a 45nm fabrication. Nehalem is a new architecture for Intel and requires a new socket, and thus a new baseboard. The Xeon 5500 comes in 11 versions, two of which are low-voltage, ten with a quad-core design, and one with a dual-core fabrication. (See Exhibit 1, at the top of the next page.) Each 5500 (except for the E5502) comes with 4 processor cores on a single die, 32KB of L1 instruction and 32 KB of L1 data cache per core, 56KB of L2 cache per core, and 2MB of L3 cache per core.

The major improvements made for the Xeon 5500 include:

- **An integrated memory controller** within the processor die – this may be the feature with the biggest impact. It eliminates the requirement for a front side bus and increases performance by lowering memory latency without increasing clock speed. This keeps the thermal envelope at the same level as the previous Xeon CPU.
- Support for up to **three channels of DDR3 memory** – increasing memory bandwidth.
- **Independent power** for each of the four processor cores – enables more control of

**Exhibit 1 –  
IBM's Xeon 5500 EP Servers**

Model	Cores	Frequency	Power
X5570	Quad	2.93 GHz	95W
X5560	Quad	2.80 GHz	95W
X5550	Quad	2.66 GHz	95W
E5540	Quad	2.53 GHz	80W
E5530	Quad	2.40 GHz	80W
E5520	Quad	2.26 GHz	80W
E5506	Quad	3.20 GHz	80W
E5504	Quad	3.20 GHz	80W
E5502	Dual	3.20 GHz	80W
L5520	Quad	2.26 GHz	60W
L5506	Quad	2.13 GHz	60W

Source: IBM

the energy management of the processor.

- **Four cores on a single die** – enables Intel to improve core-to-core communication with higher bandwidth.
- **QuickPath Interconnect** – a high speed, chip-to-chip interconnect technology that enables the 5500 CPU to connect to another component or another chip on the processor board.
- **45nm process** – the smaller architecture enables the CPU to run with lower power and higher clock speed, enabling Intel to squeeze more transistors onto the CPU die.
- **Hyper-Threading** – each core supports simultaneous multithreading (SMT), with two threads per core, for a total of eight threads, improving performance for multithreaded applications.
- **Advanced Power Management** – provides support for an additional, smaller processor core, transparent to the operating system. This power management unit manages the power envelope of the 5500 via sensors built into the main cores to monitor heat, power, and current, optimizing energy consumption as required. The Xeon 5500 also minimizes idle power, invoking a sleep state as needed.
- **Turbo Mode** – an automatic over-clocking feature enabling individual cores to be driven dynamically at a higher clock frequency, to improve application responsiveness. Turbo Mode is controlled by the power management unit and executes transparently to the operating system.

With all of the improvements made to Nehalem, the Xeon 5500 consumes 30% less energy with the same performance as its predecessor, based on data provided by Intel. However, again based on Intel's data, the Xeon 5500 provides up to 2.5 times the performance for enterprise computing, 3.5 times the bandwidth for technical computing, and double the software threads over the previous generation of Xeon CPU.

However, there is more to a system evaluation than simply a better engine. If that was all you needed, all servers would perform the same and use the same amount of energy. We know that that is not true. The data center staff also has to be concerned with TCO, total system energy requirements and overall performance. Some vendors do not consider all of these factors. With System x, IBM does address all of these concerns.

### IBM's System x

Coincident with the announcement by Intel of the availability of the Xeon 5500 processor, IBM has announced the availability of four new models of the System x family, two for rack-mount, one for *BladeCenter*, and a new version of the *dx360 iDataPlex* enclosure for Internet-scale computing. IBM has developed new platforms to not only take advantage of new features of the 5500, but they also feature innovative energy smart technology and improved systems management into each platform to reduce the TCO for the data center. The new generation of x86 servers includes the *System x3650 M2* rack server (housed in a 2U drawer), the *System x3550 M2* rack server (housed in a 1U drawer), the *BladeCenter HS22* blade server, and the *iDataPlex dx360 M2* server. All of these platforms are redesigned two-socket servers with dramatic improvements in energy efficiency, performance, management, reliability, virtualization, and flexibility in order to reduce TCO in the face of a spiraling economy.

IBM is assuming the mantle of industry leader in terms of energy efficiency with their new thermal design for both the x3650 M2 and the x3550 M2. With new voltage regulators and higher integration on the board to simplify power distribution, the data center can reduce power distribution loss. These rack-mounted servers have an energy-smart design with new lower wattage power supplies that rated at greater than 92% power efficiency, exceeding the 80 Plus Gold Efficiency standard. This efficiency includes a 60% reduction in energy use when idle and a 25%

reduction when fully utilized, over the previous generation of System x rack-mounted servers<sup>1</sup>. IBM has also innovated in the cooling arena, not only for their rack-mounted servers, but the blade and iDataPlex models, as well. IBM has included as standard in these servers a pressure-sensitive altimeter to regulate the flow of air through counter-rotating fans to improve cooling efficiency with fewer fans.

Bottom line, with the advanced power management capability provided by the *Active Energy Manager*, the IT staff can monitor, measure, and control server energy usage. The data center can save over \$100 per server per year on energy, on a one-to-one server comparison<sup>2</sup>.

In addition, these servers offer new generation systems management capabilities including *UEFI BIOS*, *Integrated Management Module*, *Tools-Center*, and *IBM System Director 6.1* for a more valuable, richer management platform.

These servers support solutions from VMware and other industry-leading virtualization software providers and provide exceptional memory capacity per core, enabling you to implement a virtualized environment efficiently and cost-effectively.

The reliability manifests itself in cross-platform *Predictive Failure Analysis* and *Light Path Diagnostics* for advance warning on power supplies, fans, disks, processors, and memory and redundant, hot-swap components so you can replace failures without taking your system down. In addition, IBM is providing hot-swap solid-state disks on these platforms to not only increase performance in high I/O solutions, but also to increase availability. With the *ServeRAID-MR10is Vault* controller, IBM offers full hardware-based encryption to protect against this new generation from security threats and costly data breaches.

In addition, with no single point of failure in the rack and blade solutions, IBM is delivering a family of servers with extremely high availability and low risk.

### **System x3550 M2 and x3650 M2**

The System x3650 M2 and x3550 M2 servers are leadership enterprise servers with significantly lower TCO as a result of IBM innovation and an energy-smart design. They have outstanding configuration characteristics with:

- Up to 128GB of memory to facilitate a virtualized environment;

- Storage capacity for 12 x 2.5" hot-swap HDDs in the x3650 M2 and 6 in the x3550 M2; and
- 4 PCIe x 8 slots (Gen 2) on the x3650 M2 (which are convertible to 2 x 16 slots) and 2 PCIe x 16 slots (Gen 2) on the x3550 M2.

### **BladeCenter HS22**

The BladeCenter HS22 offers outstanding performance, flexible configuration and simplified management in an efficient server designed to run a broad range of workloads.

IBM designed the HS22 with a focus on scalability and end-to-end virtualization, including I/O, storage, memory, management, and services. With Xeon 5500 performance and BladeCenter density, the HS22 can reduce your aging rack space by up to 95%<sup>3</sup>. IBM configured the HS22 with:

- Performance-tuned memory capacity of up to 96GB;
- Choice of hot-swap drives including SAS, SATA, boot SSD, & performance SSD;
- 8 I/O ports with up to 2 ports of 8Gb Fibre, 4 of 10Gb and 2 of 1Gb Ethernet; and
- Best-in-class server RAS and next generation systems management tools.

As with all IBM blades, the HS22 is backwards compatible with all BladeCenter chassis.

### **IBM System x iDataPlex dx360 M2**

The IBM System x iDataPlex dx360 M2 maximizes the number of servers in your data center. As part of the iDataPlex solution it provides high-computing performance with outstanding energy and operating efficiencies as it brings the Xeon 5500 into Internet-scale computing, with:

- **High Density**, using 84 high performance servers in a standard rack footprint, with high memory capacity up to 128GB of DDR3 memory in a flexible configuration;
- **Mechanically optimized, with a Rear Door Heat Exchanger** to provide maximum power and cooling efficiency, eliminating data center air conditioning, enabling the IT staff to increase data center density;
- **Flexibility** for compute, I/O, and storage configurations with a wide array of networking options; and

<sup>1</sup> Based on Intel data, 1Q09.

<sup>2</sup> IBM Power Engineering Research Study, Feb. 2009.

<sup>3</sup> IBM compared a BladeCenter HS22 to a 3-year-old HP BL360 G4 architecture.

- **Next generation systems management tools.**

### Systems Management

Systems Management is an area that IBM seems to have paid special attention to in order to help the IT staff *simplify* the data center infrastructure. Under the umbrella of Tivoli Service Management, IBM has implemented:

- **IBM Systems Director v6.1** – for the easy, efficient management of physical and virtual resources across heterogeneous systems;
- **ToolsCenter** – a consolidated, integrated suite of management tools for single-system management and scripting;
- **Integrated Management Module (IMM)** – to provide better error diagnostics, a virtual presence, and remote control to more easily manage servers from a central location; and
- **Unified Extensible Firmware Interface (UEFI)** – to provide an intuitive interface allowing applications to add hardware and firmware features and functions across the all-new generation servers quickly.

### System Director 6.1

IBM Systems Director 6.1 is a powerful, easy-to-use toolkit for managing the physical and virtual resources for cross-platform IBM and non-IBM systems. This new version provides simplified deployment, installation, and update processes, with a consistent, web-based user interface. New tasks can be quickly learned with intuitive wizards, tutorials and integrated help. The broad portfolio of systems managed by a single tool can reduce staff training and operational expenses, especially energy costs, with the *Active Energy Manager*.

### ToolsCenter

IBM ToolsCenter creates an integrated suite for the tools the data center needs to manage servers individually. The tools are organized by function: deployment, updates, configuration and diagnostics. Tools are now simpler to access and use with a single easy-to-use webpage for access, a common look and feel and a common command line interface for the scripting tools.

### IMM

The IMM, a single chip on each new generation server, combines the function of the previous BMC and RSA-II card, a video controller, remote presence, and remote disk. Remote presence is an optional feature for rack and iDataPlex servers, enabled by simply inserting a hardware key. IMM is common hardware with a single

IMM firmware across all new platforms. It requires no special IBM drivers and is configurable both in- and out-of-band. IMM uses open standards (CIM and WS-MAN) for alerts and commands to enable out-of-box integration.

### UEFI

UEFI replaces the traditional BIOS to provide a modern, well-defined environment for booting the O/S and running pre-boot applications. It is fully backwards compatible with traditional BIOS and provides additional functionality, such as no limits on the number of adapter cards, a simplified user interface and simplified management. UEFI settings can be managed both in-band and out-of-band. With UEFI, “beep codes” are eliminated and covered completely by light path diagnostics.

### Conclusion

Today's data center staff is faced with the unenviable task of lowering the TCO of the I.T. infrastructure while maintaining, or improving, performance. Intel has taken a big step in that direction by helping the enterprise to consolidate and virtualize their existing architecture with the introduction of the Xeon 5500 (Nehalem). IBM has taken the next step with the integration of the Xeon 5500 into optimized System x rack, blade, and iDataPlex modules to enable the data center to reduce the costs for energy, software licensing, floor space, and administration. With these new System x platforms, the data center can significantly reduce TCO without compromising reliability and performance while, at the same time, simplifying I.T. administration.

This new generation of servers provides the enterprise with the capability to manage present and future risk through a dynamic infrastructure in order to overcome the challenges of a spiraling economy. This new System x will help improve the delivery of I.T. throughout any enterprise, providing business value *and* reduced cost.

If you are considering an upgrade to the Intel Xeon 5500, look into what System x and BladeCenter can do for your enterprise.



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