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Optimizing the Enterprise Data Center — POWER7 Powers a Smarter Infrastructure

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Management Summary

In team sports, success or failure, victory or defeat, are measured in terms of the accomplishments of the entire team, not the success or failure of one specific individual or even one unit. In football, for example, your quarterback could be the best in the league and your offense can score at will, but the team could still lose if the defense can not stop the opposing team from scoring one point more. In baseball, a team could have the best pitcher in the world, but if the fielders continually make errors behind him, the other team will still score. Moreover, your team will always lose if the hitters fail to do their job efficiently. The performance of the offense and defense need to come together at the right time in order to achieve success. Having quality performance on both sides of the ball is just as true in the enterprise data center as it is on the playing field.

Unfortunately, there are more that just two sides of a playing field in the data center. In order to address the issues facing modern enterprises in today's society, the data center must have smarter systems integrated together to provide the information that we need to improve our lives. From research into curing heinous diseases, to reducing energy consumption in our homes and workplaces, to improving traffic patterns on our highways and city streets, we need to be able to process more information and to process it faster than ever before. To do that, we need smarter systems working together, with simplified management and systems integration that improve the ease-of-use for complex data analyses. The timeliness of information flow requires the ability to interact with, and respond to, the data being provided by an enterprise infrastructure containing millions of remote sensors. This requires a next generation of high-performance analytics, where applications can look at patterns of data and begin to predict outcomes and optimize decisions to eliminate traffic jams or minimize power consumption. It requires IT infrastructure with high performance, scalability, energy efficiency, and high availability. More specifically, high-performance computing needs to come together with high-speed communications pipes in smarter grids, along with the flexibility to provide additional compute capacity where it is needed, when it is needed. It requires the scalability to consolidate a sprawling scale-out data center within a smaller footprint with reduced energy consumption. From financial transactions on Wall Street to computational quantum chemistry in the lab, the IT infrastructure needs to provide a smarter environment for the application set.

With the announcement of a server family based upon the new *POWER7* architecture, IBM is delivering a set of tightly bundled systems based upon years of R&D, not months of patchwork acquisitions. IBM is providing an alternative to the scale-out architectures of x86 with new POWER7 systems designed to deliver more performance and flexibility than its previous generation at the same price. IBM has optimized hardware and software, bringing together elements designed to manage millions of transactions in real time. With credit to Lennon and McCartney, IBM enables the IT staff to build a smarter IT infrastructure, to "come together, right now". To learn more about these new POWER7 systems, please read on.

IN THIS ISSUE

Today's Enterprise Data Center

Today's enterprise data center is faced with a new set of limitations – trying to support an increasingly data-intensive environment with an IT infrastructure that is rapidly approaching limits in terms of performance, scalability, and energy consumption. Inefficiencies in the data center due to the proliferation of un-virtualized open systems servers deployed in a scale-out architecture results in a waste of both CPU resources and energy. **More efficient, virtualized processors not only make better use of infrastructure resources, but by deploying multi-socket, high-performance servers designed to take full advantage of virtualization features, the IT staff can consolidate the server environment, simplify systems management, and extend the life of the data center in terms of floor space and energy consumption.**

Even data centers that previously have taken advantage of the higher performance and higher efficiencies of IBM's POWER architecture have seen additional demands on system resources due to increased user count, new applications, and extended web access. Even these well-endowed POWER environments are running out of headroom and require a boost in processor capacity.

The smarter data center requires systems that have been designed to support an accelerated information flow, including the following.

- *Integrated servers* to facilitate the automated, dynamic assignment of infrastructure resources from one CPU to the next;
- *Integrated systems* to enable superior workload optimization in a high-performance transactional environment with operating system features designed to match new hardware options;
- *Integrated service management* to facilitate a fully virtualized infrastructure to enable rapid deployment and a lower TCO; and
- *Integrated services* to provide multiple delivery options to the data center, from managed services, to outsourcing, to the cloud.

In 2010, systems designed for a smarter integrated environment will be at the heart of the successful data center.

Exactly what is a smarter data center doing?

- In healthcare, for one, smarter systems are connecting medical professionals to information, to specialists, and to each other. This enables them to act proactively to improve patient management and deliver preventive and therapeutic care.
- In the greener world of energy management, where kilowatt-hours are measured in dollars, a smarter data center is required to connect consumers to a smarter energy grid where the flow of electricity can be managed to reduce energy consumption during the most expensive peak usage periods. In order to do this, the data center connected to the smart grid needs to manage data on an hourly basis, sometimes even on a minute-by-minute basis, to be able to deliver the information required for effective control.

In order to be able to respond to and process the number of transactions required in these environments, the infrastructure must be able to scale quickly and efficiently with the capability to optimize workload performance dynamically. The data center must be able to adjust the flow of resources to the servers with the highest demand, flexibly and dynamically. The platforms must be reliable to avoid downtime and they absolutely have to be energy efficient to preserve natural resources and to lower the TCO of the IT infrastructure (as well as establish a "green image" for the enterprise). In addition, the system must be able to automate management tasks to help reduce manual interaction, further reducing the TCO.

What technology provides the data center with the best option to accomplish all of these tasks? Which architecture will enable you to power your open systems IT infrastructure with the least amount of power consumption? The answer is *POWER7*.

IBM's POWER7 Family

For several decades, many of the highest performing mission-critical applications have been based upon scale-up RISC[1] systems running the UNIX operating system. Until recently, there have been multiple options in this category, notably *AIX* from IBM running on their *POWER* architecture, *HP-UX* from Hewlett-Packard, running on their *Integrity* platform powered by Intel's *Itanium* processor, and the *Solaris* operating system from Sun (now Oracle) running on servers based upon *SPARC* or x86 technology. Recent activity in the UNIX space, or lack there-

[1] Reduced Instruction Set Computing.

Exhibit 1 –Features Available in POWER7 Systems

- **TurboCore Mode** – Optimized for database or other transaction-oriented workloads by running with four active cores utilizing most of the CPU's resources; reduces licensing costs for applications licensed per core.
- **MaxCore Mode** – Optimized for maximum parallelization and high capacity with eight cores per socket and up to four threads per core.
- **Intelligent Threads** – Dynamically vary the number of active threads to increase capacity and total performance effectively.
- **Intelligent Cache** – Optimizing cache utilization by flowing it from core to core.
- **Intelligent Energy Optimization** – Maximizes performance when thermal conditions allow by powering off various parts of the system to dynamically increase or decrease processor speeds based on thermal conditions and system utilization.
- **Active Memory Expansion** – An optional innovation using memory compression for memory scalability to make the physical memory on a system appear up to twice as large for workloads that require large amounts of memory, such as SAP.
- **Solid State Drives** – An option to optimize applications with high I/O access needs.

***Source**: IBM*

of, has forced data centers running on Itanium and SPARC to reconsider their direction. IBM, with a superlative history and a clear roadmap for its servers based on POWER architecture, has taken advantage of the doubt surrounding the future of competitive platforms to deliver, on schedule, the latest models in their binary-compatible family of AIX servers, these being based on *POWER7*.[2]

These new POWER7 systems include a number of innovative technologies for the unique demands of new applications and services that require processing very many concurrent transactions and much data while analyzing that information in real time. IBM has accelerated the parallel processing capabilities of POWER7 systems, via tightly integrated hardware and software. In addition, IBM has enabled the POWER7 data center to improve resource utilization with advancements in virtualization, energy efficiency, memory use, and price/performance. This continues IBM's leadership role in transaction processing and enables IBM to take a giant-step forward in throughput computing optimized for running massive Internet workloads. See Exhibit 1, above, for automatic workload optimization features on POWER7 Systems.

With the higher performance provided by POWER7 CPUs, enterprises with new POWER7 systems can realize an outstanding ROI as they manage millions of transactions in real time from pools of POWER7 systems optimized for Internet workloads. The data center can then analyze the data resulting from these new emerging applications, as we saw above, with the energy management requirements of the smarter grid. **Whether the enterprise requires massive parallel processing, high levels of throughput computing, or the ability to run analytics, POWER7 brings all three capabilities together, now.** Additional ROI gains can be realized from the energy-efficiency, flexibility, and scalability provided by POWER7 to affect mission- and business-critical data center activities. In fact, using *rPerf*[3], IBM has demonstrated that POWER7 systems have significantly more performance and virtualization capability than the previous generation POWER6 servers[4] do, for the same price. For example, a single node Power 780 has an rPerf rating of 195, compared to an rPerf of

[2] For more on POWER7, see **The Clipper Group Navigator** entitled *IBM Takes Command of the UNIX Data Center - POWER7 Enables Growth, Lower Cost* dated September 21, 2009, and available at http://www.clipper.com/research/TCG2009040.pdf.

[3] rPerf (Relative Performance) is an estimate of commercial processing performance relative to other IBM UNIX systems. It is derived from an IBM analytical model using characteristics from IBM internal workloads, TPC, and SPEC benchmarks.

[4] For more on POWER6, see **The Clipper Group Navigator** entitled *UNIX Consolidation and Virtualization - IBM Supercharges System p with POWER6* dated June 12, 2007, and available at http://www.clipper.com/research/TCG2007069.pdf.

141 for a four-node Power 570 with POWER6+ technology, an rPerf of 35.25 per node. Even more significantly, the single-node 780 only consumes 1600 Watts, compared to 5600 Watts for the four-node 570.

Similar advantages are also available from POWER7 servers when compared to competitive SUN SPARC and HP Integrity models[5]. IBM has reaffirmed their leadership in the multi-billion dollar UNIX market. **POWER7 benchmarks prove that IBM's POWER servers have the scalability to provide the data analysis required by today's complex IT infrastructures.** Doubts still exist regarding the future of SPARC in an Oracle-based environment, not to mention the future of Itanium, based upon the decrease in R&D investment reflected in HP's recent earnings announcement.

IBM recently announced four new 45-nanometer POWER7 models to address a variety of data center requirements, with four, six, or eight cores per socket, up to four threads per core, and up to 64 cores available to address new mission-critical application requirements. POWER7 cores run at speeds ranging from 3.0 to 4.14 GHz, with dynamic energy optimization to reduce power consumption. Each POWER7 CPU has 32MB of integrated eDRAM L3 Cache to accelerate performance. IBM has also issued a Statement of Direction for a new high-end server with up to 256 POWER7 processor cores, designed to operate within the same footprint and energy envelope as the current *Power 595*, with an upgrade path from the 595.

The new POWER7 models include the IBM *Power 750 Express* and the IBM *Power 755*, available now, and the IBM *Power 770* and the IBM *Power 780*, with availability planned for March. All of these models can run AIX, IBM's UNIX operating system, along with total integration with the IBM *i operating system*[6] (System i) and a scalable Linux solution ready for Linux application consolidation, whether coming from x86 or elsewhere.

IBM POWER7 systems also come with:

- *PowerVM* with *Live partition Mobility*[7] – an option to drive virtualization, with up to 90% utilization, supporting 1000 virtual servers on a single system[8];
- *PowerHA* – an option for resiliency without downtime;
- *Dynamic Energy Optimization* to help reduce energy costs by 70-to-90% with IBM's *EnergyScale* technologies; and
- IBM *Systems Director Express*, standard on every Power System, has three options: *Express*, *Standard,* and *Enterprise Edition*, offering new, simplified packaging of management software for these new systems, including the automation of virtualization management with *VMControl,* enabling a "systems pool" of multiple Power servers to be managed as a single entity.

Power 750 Express

The *Power 750 Express* is an Energy-Star qualified system designed for the mid-market enterprise, the first Energy Star certified RISC system. It offers four times the processing capacity of its predecessor, IBM's *Power 550 Express*, with the same energy envelope. With four sockets deployed in a 4U chassis, with either six or eight cores per socket running at 3.0 to 3.55GHz, this system has up to ten times the performance of a comparable *HP Integrity rx6600*[9] and is three times more energy efficient than a *Sun SPARC Enterprise T5440*[10]. In fact, the data center can consolidate up to 92 Sun SPARC Enterprise T2000s on a single Power 750. This saves 97% on floor space, 95% on energy, and up to 95% of the software licensing due to reduced core count.

When measured with the industry-standard SAP benchmarks, a four-socket Power 750 Express with DB2 outperforms eight-socket HP and Sun systems and has comparable performance with a 128-core, 32-socket *Sun M9000*, which potentially carries much higher software costs because of the much higher core count. A Power 750 Express starts at $190K for four eight-core 3.3GHz Power7 CPUs.

Power 780

The *Power 780* represents a new category of scalable, high-end servers. With an ad-

[5] The key here, however, lies even more with IBM's history of binary compatibility with continuous scalability, performance, and energy efficiency, protecting enterprise investment, well into the foreseeable future.

[6] IBM i is not available on the Power 755 because the 755 is designed for HPC workloads.

[7] An option available with *PowerVM Enterprise Edition*.

[8] According to IBM.

[9] Based upon the IBM SPECint_rate2006 benchmark dated January 2010 and the HP SPECint_rate2006 benchmark dated August 2006. For the details, go to http://www.spec.org.

[10] Based upon performance per watt.

vanced modular design supporting up to 64 POWER7 cores, the Power 780 supports IBM's new *TurboCore* mode to optimize transaction-oriented workload. TurboCore enables the data center to run a POWER7 system with only four active cores, but with most of the resources from all eight cores of the CPU, delivering twice the performance per core of a POWER6 system. Each Power 780 CPU runs at either 3.86 or 4.14GHz and comes with *optional Capacity on Demand* and enterprise RAS capabilities.

The Power 780 is ideal for applications with high per-core performance requirements. In fact, a single Power 780 with 80% utilization can replace eight 64-core HP Integrity Superdomes running at 30% utilization. With an 87% savings in core count, the data center will realize significant savings in software licensing, floor space, and energy costs.

Power 755

The *Power 755* is a high-performance computing cluster node, Energy-Star qualified, and has 32 POWER7 cores. It is optimized for the most challenging analytic workloads.

Power 770

The *Power 770* is the successor to the Power 570, with up to four nodes and up to 64 POWER7 cores running at 3.1GHz or up to 48 cores at 3.5GHz. It has higher performance per core then the 570 and uses up to 70% less energy than a comparable 570. The Power 770 comes with the same enterprise RAS features and optional Capacity on Demand as the Power 780.

Conclusion

IBM's new POWER7 systems are designed to manage the most demanding emerging applications, ranging from smart electrical grids to real-time analytics for financial markets. The new systems incorporate a number of unique technologies for the specialized demands of new applications and services that rely on processing an enormous number of concurrent transactions and data while analyzing that information in real time.

IBM's POWER7 architecture is the ideal destination for the enterprise that requires massive parallel processing, high levels of throughput computing, and the ability to run analytics to deliver smarter solutions. POWER7 brings all three capabilities together, right now.

POWER7 systems scale quickly and efficiently in order to optimize workload performance with resilience to avoid downtime. For the enterprise with a green conscience, and commitment, POWER7 systems have the dynamic energy optimization required to reduce energy consumption. Moreover, with automated management, POWER7 systems enable the data center to lower the TCO for the IT infrastructure.

Whether your enterprise has deployed a scale-up RISC environment with a UNIX operating system or Linux on scale-out open systems servers, POWER7 provides the ideal destination to enable a smarter infrastructure.

- If you have a POWER6 environment deployed, POWER7 provides you with binary compatibility with significantly improved performance and energy efficiency.
- If you are running UNIX on a HP Integrity or Sun SPARC platform, IBM can provide you with a migration path that will increase your performance, flexibility, and resilience for years to come.
- If you are running Solaris or Linux on an x86 architecture, IBM can provide you with a consolidation platform that will reduce energy consumption and TCO significantly.

Simply put, in order to reduce power consumption, your data center can go faster with less energy via more POWER.

If your enterprise has workloads that demands improved high performance, transaction processing, and integrated analytics in order to deploy a smarter data center, you need to review the capabilities of IBM's POWER7 systems.

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