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The IBM Power Scale-out Advantage

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Executive Summary

RFG perspective: the corporate IT x86 server business model is approaching the end of the road as it is predicated upon the price/performance of Intel Corp.'s x86 server chips declining year-over-year. The collapse of this model impairs big data and analytics, cloud, and mobile computing initiatives and provides IBM Corp. an opportunity to regain market share with its recently refreshed Power Systems product line. A system stack built upon the new POWER8 microprocessors could restore the price/performance model that users need and therefore, IBM could start to reclaim application workloads lost to x86 servers over the past decade. Thus, applications running on the new IBM POWER8 servers should enable enterprises to achieve lower total costs of acquisition (TCA) and operations (TCO) along with the advantage of business-critical characteristics and capabilities compared with commodity x86 servers.

Much of the growth in corporate data center environments today is fueled by distributed, virtualized architectures that offer an attractive combination of low cost of entry, manageability, and processing performance. Linux is employed on a significant and growing portion of these solutions as it is rapidly gaining market share due to its cost (free), plethora of applications and development frameworks, and growing talent pool. Unsurprisingly, many companies choose systems based on the x86 platform out of habit and the belief that x86 solutions offer the right mix of future scalability, least cost, and smallest data center footprint. However, IBM's POWER8-based Power Systems solutions provide more performance per dollar, better availability and scalability characteristics, and deliver improved scale-out scenarios while occupying much less rack space than their competitors. This paper examines the cost and architectural strengths of IBM's latest Power Systems scale-out solutions POWER8 against the leading Intel Xeon Ivy Bridge competitive platforms for open source and other Linux-based workloads.

The Collapsing x86 Server Model

Ever since IT executives started betting their business on Intel-based servers, IT executives have counted on the price/performance ratio improving annually. It is a simple business model – more processing power for less money year-over-year. As a result, Intel servers now account for 98 percent of all server shipments and 70 percent of all server spending whereas Unix/RISC server revenues are about 15 percent of the market and shrinking. But this trend could change as the price/performance of Intel server stacks are struggling to stay on the price/performance curve and IT executives search for alternative solutions (see Figure 1).

Originally users and vendors could count on Intel improving clock speeds, increasing densities and shrinking the chip size. But the physical limits for x86 chips have been reached, so vendors are innovating in other ways – operating system advances, more memory, optimization, etc. But as the chart shows, it is becoming quite difficult to remain on the curve predicted by Moore's Law.

This provides an opportunity for the new generation of IBM Power Systems built upon the POWER8 microprocessors to grow market share in the scale-out sector of the market. The Power Systems are continuing to deliver scale-out solutions that conform to the price/performance track IT executives require while providing a 50 percent or more total cost of acquisition (TCA) improvement over two-socket x86 alternatives. In addition to the performance-enhancers IBM has implemented in the new Power Systems servers, IBM has created the OpenPOWER Consortium and is working with the participating vendors to deliver innovative solutions across all layers of the hardware and software stack. IT executives should expect IBM and OpenPOWER vendors to deliver solutions over the next few years that meet the price/performance curve requirements while it is unclear whether Intel and its partners can change its trajectory, even with the new Haswell chips.

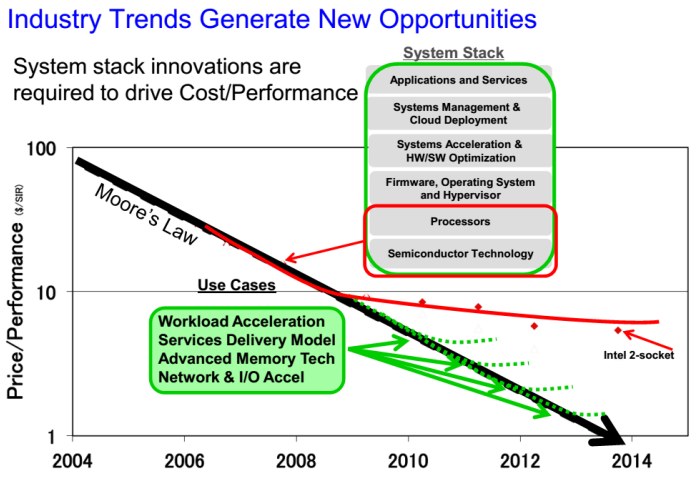


Figure 1. The x86 Price/Performance Curve

The Price/Performance Dilemma

There are a number of factors that buyers frequently overlook, which can result in choosing the wrong server platform. IT executives and procurement personnel should evaluate the TCA and TCO of running similar workloads across "like" systems on Power System and competitive x86 servers and include a projected performance growth that realistically reflects operational expectations for every year over a three-year period.

Included in the analysis should be an expected sustainable utilization rate that will be achieved by the Power System processors and comparable x86 servers. Utilization impacts the number of server cores needed. IBM will guarantee Power Systems users can achieve a sustainable utilization rate of 65 percent. RFG and other studies find Power Systems clients typically achieve a sustainable utilization rate of just under 50 percent while most x86 servers are hard pressed to sustain a utilization rate of 35 percent. Furthermore, Power Systems servers have consistently allowed users to operate systems at levels greater than 65 percent utilization without problem whereas the x86 servers tend to not exceed 40 percent utilization without starting to experience significant instability. Moreover, the majority of installed x86 systems operate at less than 20 percent of capacity.

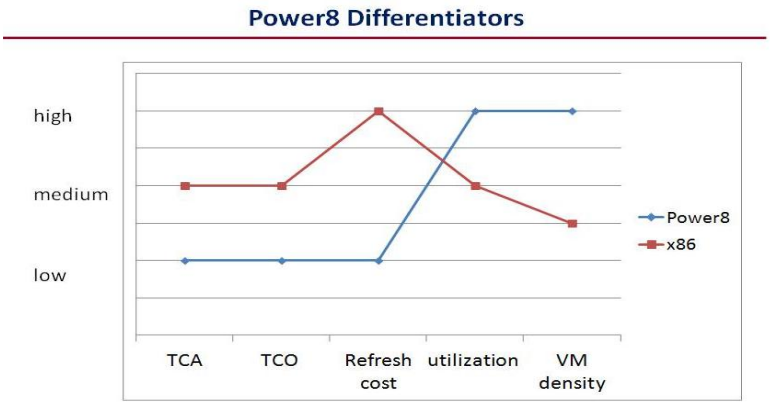
The utilization rates should accurately reflect real-world, achievable performance that will occur in the enterprise's data center. At a minimum, the TCA should include all of the hardware and software acquisition costs while the TCO analysis should include the initial and ongoing hardware, software, people, power, and facilities costs. One can also include backup, development, test and/or disaster recovery systems into the analysis. When a detailed analysis of the TCA and TCO is performed after

adding these criteria, it is highly likely that the Power Systems solution is the better price/performer with superior TCA and TCO results.

POWER8 Differentiators

RFG examined five characteristics to determine why there is significant differentiation between the POWER8 servers and traditional x86 servers. We evaluated TCA, total cost of ownership (TCO), refresh cost, utilization, and virtual machine density. As noted already, the POWER8 solutions offer lower TCA and TCO outcomes than comparable x86 offerings. **In addition, the refresh costs are significantly different as IBM allows for upgrades to their Power Systems servers while the competitive x86 solutions require a whole new purchase.** This refresh capability significantly enhances the Power Systems offerings when the TCO is computed over a five year period, instead of the usual three years.

When one considers the differentiators as a whole, it is easy to see the POWER8 servers exhibit attributes vastly different than those of x86 processors. From a financial basis to operational characteristics Power Systems offer a totally unique value proposition. (See adjacent figure.)



The concept that starting small means installing x86-architected servers may perhaps be the biggest misnomer in application development and packaged application deployment. Workloads such as Apache, ERP and PHP applications and databases such as MongoDB, MySQL and SQL are ideally suited for implementation on Power Systems servers. In addition to being cost competitive and more powerful than x86-based competitors, Power Systems solutions deliver better application mobility, improved scalability, increased virtualization performance, and less downtime**. The PowerVM hypervisor can scale workloads better within a single box as its maximum virtualization performance is almost 35 percent greater** than workloads running VMWare. Additionally, applications can be moved or duplicated without requiring significant administrator effort or applications to be shut down – critical elements in preventing outages. When hardware upgrades are required, deploying on the Power architecture provides the added advantage of allowing companies to reduce floor space by maintaining or reducing servers, or, further consolidating workloads seamlessly onto more vertically-integrated Power systems.

The greater server utilization capabilities afforded by Power Systems platforms helps reduce data center server sprawl and offers paths to maintain, and even reduce, footprint requirements at refresh cycles. Moreover, a **2:1 benchmark performance advantage, greater utilization (which can drive the performance advantage up to 4:1) within systems and fewer systems on the data center floor** reduces data replication tasks while Power System servers inherently provide superior buffers to deal with surging workloads. Furthermore, the reduced level of complexity simplifies disaster recovery. The

reduction of these administrative complexities can help IT executives deploying Power Systems solutions to not only streamline data center operations and costs, but to also unburden employees so they can focus more on revenue-generating and performance-enhancing tasks instead of ongoing operations.

Common Practices Aren't Necessarily Best

Whenever IT architects, designers, and executives think about placement of new Linux applications on servers, the most common conclusion is to put the applications on x86-based servers. Frequently missing from the initial infrastructure decision-making process is a multi-year operational outlook that addresses growth and performance. Hence, what may be a best practice for low-growth business-critical systems or a low-usage, non-critical application may fall far short of being a best practice when the application grows to encompass tens, hundreds, or thousands of servers and is business-critical. Many IT professionals will claim that the scale-out x86 platform satisfies the performance and utilization requirements with the use of current virtualization platforms and strategies. However, this is not the case and the facts do not support it.

Furthermore, processor utilization is not always the gating factor for x86 servers; memory or channel utilization can impair performance. These bottlenecks and constraints greatly limit the number of applications and workload that can be placed on an x86 server, making it necessary to scale out to multiple processors and endure the ensuing increases in complexity and costs.

The new IBM Power Systems solutions built on POWER8 chips alters the landscape of possibilities by providing IT organizations with persuasive alternatives to the status quo. The IBM Power Systems single-socket and two-socket servers are more efficient, cost-effective servers designed to run AIX and industry standard Linux workloads while delivering improved scalability, lower costs, and superior levels of service. IBM has aggressively priced these Power System offerings so that the TCA for comparable x86 one- and two-socket solutions can be 2x the cost of the Power System servers or more. Similarly, the TCO for the comparable x86 server solutions can be up to more than 300 percent more expensive.

Workload Considerations

There are numerous technical reasons to implement solutions on Power System servers beyond the financial ones. The POWER8 chip incorporates a Coherent Acceleration Processor Interface (CAPI). The CAPI port interfaces with the PCIe slot and enables external components such as accelerators and flash memory to directly communicate with the server's memory. No operating system drivers are needed to utilize this feature. Initial IBM performance tests indicate a use case that shows a 24:1 CAPI Flash consolidation advantage over an x86 configuration designed to handle the same capacity while slashing costs by two-thirds.

Additionally, the Power System servers are optimized to support AIX and industry standard Linux operating systems (SUSE Linux Enterprise Server, Red Hat Enterprise Linux, and Ubuntu Server) by exploiting workload advantages of POWER8, PowerKVM (Linux only) and PowerVM – yielding better performance, RAS (reliability, availability, and serviceability), and virtualization by being tuned to the

environment. IT executives can order these solutions factory pre-loaded and get them delivered with an installation toolkit so that they can quickly become operational.

The PowerVM hypervisor offers capabilities beyond those obtainable on a commodity server with features such as active memory sharing, dynamic logical partitioning, and live partition mobility. With live partition mobility applications can be moved with minimal effort and without application shut down. This reduces the number of outages, allows for quiescing processors during low levels of utilization to save on power consumption, or swapping of servers without impact to business operations. Moreover, unlike VMware's vSphere5.1 which only allows 96 GB of memory per socket, PowerVM does not have a virtual memory cap. Memory limitations can be problematic for a number of workload types that require a lot of memory. With PowerVM POWER8 servers can increase workloads within a single system up to 32 times to achieve superior memory and processor utilization levels.

The new IBM PowerKVM hypervisor provides an open virtualization platform choice for scale-out Linux users on the POWER8 servers. It is managed like any other KVM host and comes with open source tools so that users can avoid proprietary vendor lock-in. PowerKVM is designed to exploit POWER8 features like "micro-threading" and symmetric multithreading, with up to eight threads per core. The hypervisor optimizes real memory and allows for memory to be overcommitted and swapped out when inactive.

Additionally, Power Systems' increased utilization and scaling capabilities reduce data center sprawl and offer multiple alternatives to maintaining, and even reducing, footprint requirements at refresh cycles. Furthermore, they will also reduce data replication tasks, enable systems to handle workload spikes, and simplify disaster recovery; and these characteristics end up shrinking the synchronization time needed in the nightly batch window. The net is all these Power Systems features streamline operations and costs while improving service to users thereby enabling administrators to focus more on revenue-generating and performance-enhancing tasks instead of ongoing operations. It will be years before x86 solutions can match today's Power System capabilities.

Conclusions

RFG POV: Power Systems are an investment that starts paying for itself immediately by saving money up front by requiring fewer servers and providing a better value proposition. Power Systems servers are not only more powerful and less costly than competing solutions from x86 providers, but also offer a better path forward for business-critical enterprise solutions by allowing growth into higher-end scale-out and scale-up architectures. On these and other merits, IBM’s Power Systems solutions offer a compelling alternative for Linux-based x86 platform deployments to products from competing vendors. Powered by a combination of IBM’s POWER8 microprocessors, PowerKVM and PowerVM server virtualization technology, Power Systems deployments require fewer physical boxes for a given workload and scale more efficiently to meet growth requirements.

IT executives need to evaluate more than the initial x86 system requirements and look out three to five years so as to avoid adopting a “rip and replace” approach to meet surging usage and business needs. In

addition to being less expensive on TCA and TCO bases, Power Systems hardware delivers productivity advantages found by lowering administration costs and data replication and synchronization complexities. But IT executives should not be purchasing servers based on TCA perceptions alone. IT executives need to perform technical and financial evaluations for the Power Systems and x86 platforms for their business- and mission-critical applications and select the server solutions that best satisfy their current and future business, financial, and technical requirements for each workload. While x86 solutions will still dominate the market, Power Systems solutions should prove to be the right choice for a number of IT executives that perform an unbiased analysis of the options.

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