CLABBY ANALYTICS

Opinion

Will New Technology from IBM Power Systems and Intel Drive Itanium and SPARC Out of the Market?

Executive Summary

The midrange/high-end server market is about to undergo a major change as information technology (IT) buyers gravitate toward three server architectures: Intel x86-based multi-cores; IBM POWER, and IBM z. As this occurs, sales servers based on Intel's Itanium chip set will decline — as will sales of servers based on Sun's SPARC architecture.

Here are the data points that have lead *Clabby Analytics* to these conclusions:

- IBM's POWER architecture continues to perform admirably — and, over the past three years, has gained market share in the Unix marketplace against Hewlett-Packard (HP) and Sun.
- A new version of POWER (POWER7) is expected in early 2010 — and this version promises to very significantly increase processing power while also offering visualization and virtualization improvements. Given the solid competitive position of this processor; its large installed base; and its advanced functionality (years ahead of x86 in virtualization, for instance) — POWER architecture can be expected to continue its dominance in the server market mid-range and high-end.
- Intel is expected to release its Beckton multi-core processor in early 2010. This Xeon-class processor is expected to be the focal point for Intel's 64-bit development efforts for the foreseeable future. Its 64-bit functionality and its reliability/availability/security (RAS) features are expected to overlap with and marginalize Itanium. Sales of Itanium-based servers should, accordingly, decline significantly because the market has already shown a clear preference for x86 architecture — and because the x86 ecosystem is far richer than that of the Itanium ecosystem.
- Mass migration away from Sun SPARC architecture is already taking place (both IBM and HP are reporting an increase in Sun migrations). We believe this is directly attributable to Sun customer concern about Oracle Corporation's pending takeover of Sun — and we believe that it will be very difficult for Oracle recover these lost customers.

> ***If the market does consolidate around POWER, x86, and z — then Clabby Analytics sees even more bad news for HP and Sun as both companies have built their virtualization value-adds into their operating environments. If Itanium collapses, then much of HP's value-added extensions (contained in HP's HP/UX, Open VMS, and NonStop operating environments) collapse with it. And the same applies to the Sun virtualization value-add contained in Sun's Solaris operating system.***

As this consolidation takes place, the competition between Intel Xeon and IBM POWER will heat up. Intel's new Xeon multi-cores will be powerful processor environments — but

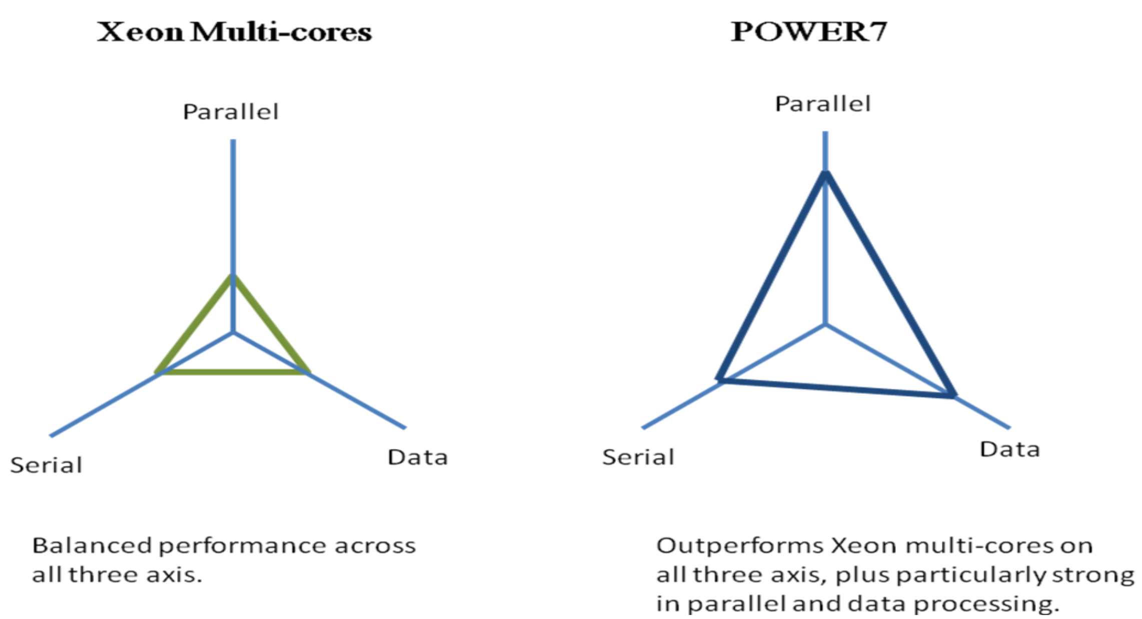
it will take years for Xeon to catch up to IBM's POWER in terms of database processing capabilities, visualization, virtualization, RAS, and integration (and meanwhile, IBM will continually advance POWER — meaning Intel will constantly be trying to hit a moving target as it attempts to catch POWER). *Clabby Analytics* will be particularly interested to see if IT buyers will opt for Intel multi-cores and attempt to fill-in-the-gaps using x86 ecosystem independent software vendor (ISV) solutions — or whether IT buyers will recognize how much more advanced (and how much better integrated) IBM's POWER environment is — and resist the temptation to buy lower-cost x86 servers and perform integration and testing themselves.

The remainder of this *Opinion* provides additional insights and perspectives on the forthcoming server consolidation trend around x86, POWER and z architectures. It also takes a closer look at some of the comparison points that should be weighed when choosing between Xeon multi-cores and POWER-based servers.

The Forthcoming Server Market Consolidation: Positioning the New Xeon Multi-cores

When *Clabby Analytics* evaluates servers, we tend to look at server performance on three axes: parallel, data processing, and serial processing performance And what we are *expecting* to see when Xeon-class Beckton multi-cores are released is balanced performance across all three axis. Further, we are also expecting to see IBM's POWER7 perform well across all three axes. But, because of POWER7's advanced multiprocessing microprocessor design — and its more advanced virtualization capabilities — we expect that POWER7 will far outperform Beckton when measured using the same axis comparison Figure 1 visually represents what we expect to see when both architectures are released — but the actual raw data on each processor will not be available until each is announced. Hence, *this graphic is a theoretical representation of how each architecture will behave* when measured on parallel, data processing, and serial processing axis.

Figure 1: Theoretical Expectations — Intel Xeon Beckton and IBM POWER7



Source: Clabby Analytics — January, 2010

The key point in this section is this: Intel's x86 Xeon multi-cores are positioned for balanced performance — and will challenge IBM POWER and even mainframes over time. IBM's POWER7 will greatly increase Power Systems performance (giving POWER a large performance edge); while advanced virtualization facilities that will be released along with POWER7 (described later in a section titled: "POWER vs. x86 Virtualization: 3 Major Differences") will enable far greater utilization of POWER-based systems as compared with Xeon multi-cores. But, there is no denying that Xeon is moving up the food chain — and will ultimately be positioned as a balanced workload processor — and as such, it will take aim at POWER and z.

How Clabby Analytics Believes This Server Market Consolidation Will Impact HP

The overlap of Xeon multi-cores with Itanium could prove catastrophic for Itanium in the general purpose processor market because Xeon multi-cores are expected to become the "industry standard" for 64-bit computing ─ relegating Itanium to the class of "special function processors" (such as IBM's zIIP, zAAP, and IFL). These specialty processors are designed and optimized to perform certain tasks such as Java or database processing well ─ while more mainstream processors such as x86, POWER, and z processors are designed and optimized for general workload processing.

A shift in Itanium's role at HP would also have a huge impact on HP's operating environments and systems design strategies. Here's why:

- Currently, HP's operating environments are all tied to Itanium architecture. If Itanium becomes a low-volume, specialty processor, then HP's operating environments (more specifically, HP/UX, NonStop, and OpenVMS) ultimately become low volume specialty solutions.
- Virtualization (resource pooling) is one of the hottest market segments in the computer industry. HP's investment in virtualization, however, is tied to the fate of its Itanium-based servers (HP's "Integrity Virtual Machines" is HP's resource sharing technology — and it is tied to its Itanium-based servers).
- Should Itanium take a nosedive, then HP's Itanium-focused virtualization products will take a nosedive. This will make it harder for HP to justify further investment in building its own virtualization products (and could, effectively, take HP out of the virtualization marketplace).
- HP also invests in Itanium systems designs (towers, blades, and high-end Superdomes). If x86 architecture undermines Itanium, then it also becomes difficult to justify further investment in Itanium-based systems designs.

To reduce design costs, HP may ultimately be forced to use its blade chassis as the only system design for Itanium-based servers. Releasing Itanium-based servers in a blade form factor would make a lot of sense because HP is already investing heavily in blade design to support its x86-based server line — so adding Itanium-based specialty processors to existing blade chassis would minimize HP's Itanium-based system/server design costs.

How Can HP Work-around These Problems?

One way to work around this problem would be for HP to port HP/UX to x86 multi-core architecture. However, should HP decide to port HP/UX and its virtualization extensions onto x86, it will find itself marketing its own virtualization solutions (Integrity Virtual Machines) against its already established x86 independent software vendor partners. More specifically, HP would end up marketing its HP/UX operating environment against virtualization extensions in Microsoft Windows Server and Novell/Red Hat Linux operating environments ─ and also against VMware, Microsoft Hyper-V, Citrix Xen, and other third party and open source virtualization solutions that have already established a solid presence in the x86 market.

On the other hand, if HP chooses not to move its HP/UX and its virtualization products to x86, then HP/UX fate would be tied to a declining systems environment (Itanium). Further note that revenues have declined steadily in the Unix market over the past four years ─ giving up ground to far-less-expensive Linux. And HP/UX has also lost market share to IBM AIX over this time frame. So HP/UX would not only be tied to a declining hardware base ─ it would also be tied to a declining operating system market.

> ***If HP/UX is not ported to x86, its future looks awfully bleak. A decline in Itanium sales combined with the potential for ongoing decline in Unix market share does not bode well for HP/UX on Itanium.***

Given this scenario, HP's choice then becomes to either:

1) Migrate its HP/UX virtualization code to x86 architecture in order to continue to play in the virtualization marketplace; or
2) Rely on its ISV's for hypervisor/virtualization/infrastructure/management code.

In either case, HP can still "play" in the virtualization market. In the former case, HP can port HP/UX to x86 and then challenge its operating system and virtualization business partners for operating system and infrastructure revenue. In the latter case, HP can help its partners by focusing on virtualization at a higher level (such as integrating systems, storage, and network virtualization). It will be interesting to see which choice HP makes…

In the end, a strong market move toward x86 multi-core architecture has the potential to take HP completely out of the operating system/virtualization business altogether. Why? Because HP/UX and Open VMS customers can move to a rich alternative operating environment with a strong ecosystem and a strong growth path: Linux (on x86, POWER, or mainframe platforms).

When multi-core x86 servers arrive, why will HP customers continue to need HP/UX? As for the HP's highly-available NonStop operating environment, this environment requires heavy investment in systems design in order to provide the kind of redundancy needed to assure 99.999% or greater reliability. And, as mentioned earlier, it is difficult to justify investments in advanced systems design based-on a declining microprocessor architecture. Meanwhile, mainframes offer a well-funded, proven alternative to NonStop…

> ***Ultimately, HP could become an x86-only vendor that is left marketing two operating systems on x86 architecture — Windows and Linux (neither of which HP creates). HP's remaining operating environments (OpenVMS, NonStop, and HP/UX) would essentially go into maintenance mode until they fade away.***

How Clabby Analytics Believes This Server Market Consolidation Will Impact Sun

How did Sun, one of the computer market's finest innovators (Java, Open Office, Solaris, etc.), end up as a buy-out victim? *Clabby Analytics* believes the primary reason that Sun failed is due to its refusal to recognize its failings in microprocessor/server design.

Consider these points:

- Sun had one early success in microprocessor/server design. As a Unix workstation company, Sun's natural progression was into the low-end of the Unix server market space. So, in the early 1990s, Sun designed and built its own Unix-/SPARC-based low end server. And, as luck would have it, Sun's timing was perfect. Sun's low-end Unix server came to market just as business use of the Internet took off ─ and the need for Unix-based Web (Apache) servers mushroomed. Other vendors (HP and IBM) were building high-end Unix servers at a time when Sun's server product line was comprised of small servers. As a result, Sun had no real low-end competition ─ and, accordingly, made huge inroads into the server market. This "fortunate happenstance" of product positioning enabled Sun to quickly become the Unix server volume leader.
- In the mid-1990s, Sun decided to expand into the high-end of the Unix market. Using its own developmental resources, Sun was building its own high-end enterprise servers when, in 1995, another "fortunate happenstance" occurred. One of Sun's business partners, Cray Business Systems had architected a powerful, high-end Sun UltraSPARC-based server (a wonderful design that featured a high-speed switching architecture). Cray was sold-off to Silicon Graphics, Inc. (SGI) which immediately turned around and sold this Cray Business Systems high-end UltraSPARC environment to Sun (for a paltry sum of only $50 million!). Shortly thereafter, Sun's very successful ES10000 was born.

This purchase has been classified as one of the best technology deals of the decade — but note, it was the result of an acquisition of someone else's technology — Sun was unable to bring its own high-end design to market.

- After its acquisition of Cray Business Systems, it was up to Sun engineers to constantly refresh Sun's UltraSPARC microprocessors and servers. And Sun engineers were not up to this task. Constant slippage of successive generations of UltraSPARC processors left Sun customers waiting years for product refreshes. Sun's UltraSPARC III was years late to market — and Sun's UltraSPARC V was cancelled.
- As Sun struggled getting UltraSPARC releases out the door, the company determined that it needed to invent yet another microprocessor architecture if it wanted to keep pace with the rest of the market (single core processors were running out of headroom and other microprocessor makers were moving to multi-core designs). So Sun embarked on a program to build its own multi-core processors. And yet again, Sun engineers were not up to this task. Unable to build its own high-end design, Sun chose to buy an advanced multiprocessor design from former Sun engineers at a company called "Afara Websystems". This line of

processors (codenamed "Rock" — a cellular multiprocessing processor design) may ultimately be cancelled.

Sun became successful in the computer market by being at the right place at the right time with small servers just as the need for small, Unix-based Web servers took off (and competitors had no competing products to offer). And Sun continued that success by acquiring Cray Business Systems' Starfire server to enter into and compete extremely favorably at the high-end of the Unix market. But since 2001 when the bubble burst, Sun has been unable to return to its former glory. Sun's inability to get products out the door on time ─ and Sun's tardiness with its CMP architecture ─ put the final nails in the coffin of customer confidence in Sun servers.

> ***Should the Sun acquisition happen, Oracle will need to invest heavily in microprocessor design in order to continue to compete with Intel Xeon and IBM POWER. Given Sun's history in microprocessor design and the company's failure to meet its release schedules, it may not be wise for Oracle to continue investing in Sun-created microprocessor architectures…***

How Clabby Analytics Believes This Server Market Consolidation Will Impact IBM

Intel's x86 multi-cores will present IBM with opportunities as well as challenges. On one hand, IBM has an excellent x86 product set in its System x architecture (so IBM is already poised to take advantage of the market move to Beckton and post-Beckton processors). But on the other hand, Beckton and subsequent generations have the potential to challenge IBM's POWER Systems and mainframe bases — and therefore require a competitive response.

Given this new multi-core competitive situation, IBM has developed three competitive approaches when it comes to selling x86 multi-core servers; selling against x86 multi-core servers; and selling with x86 multi-core servers. These include:

1. A *homogeneous* approach (in order to compete head-to-head with Dell and HP);
2. A *competitive* approach that differentiates IBM POWER Systems and mainframes from x86 servers (for cases when x86 servers compete with POWER Systems, and with mainframes);
3. A *blended heterogeneous* approach that incorporates all of IBM's server brands (System x, POWER Systems, and System z) into a cohesive environment where workloads are assigned to the server environment that can best process the task at hand. (This approach is also known as a "heterogeneous cloud" approach).

A Closer Look at IBM's POWER Architecture vs. Intel Xeon Multi-core Approach

When IBM Power Systems compete against x86 architecture (scenario 2 — above), they compete on the basis of:

- Highly advanced systems designs that feature extraordinary redundancy, memory management, power management, cooling, and other functions;

- Superior microprocessor capabilities (for instance, POWER can be micro-partitioned to increase processor utilization);
- Advanced RAS (in both systems and software design);
- Advanced virtualization capabilities (Power Systems feature virtualization capabilities and technologies that have cascaded down from the most powerful virtualization environment in the industry — the mainframe).
- Heterogeneous management (cross platform systems management at both the physical and logical level; and especially in the area of heterogeneous storage management);
- Homogeneous server management (monitor/control, visualization, security, etc); and,
- The level and extent of automated management functions.

Of these comparison points, Power Systems advanced virtualization capabilities are worth much closer scrutiny as they constitute probably the most major competitive advantage for Power Systems architecture.

POWER vs. x86 Virtualization: 3 Major Differences

Three major differentiators quickly surface when comparing Power Systems to x86 systems virtualization. They are:

1. The "virtualize everything" design concept;
2. Virtualization prioritization; and,
3. Memory management.

Virtualize Everything
A fundamental design difference exists when comparing x86 systems design to Power Systems design when it comes to virtualization. Power Systems using PowerVM have been designed to "virtualize everything" such that *all systems resources* (including memory, CPU power, and databases) can be made available as needed in a prioritized fashion to applications. This design point is particularly important when a Power Systems IT manager or administrator wishes to run applications that need to interact with a large database. In the Power Systems world, the entire system (except for the minimum guarantee per partition) can be dedicated to running workloads and driving large, co-resident databases.

By contrast, x86 virtualization is generally limited to 8 virtual CPU (central processing units) per system. But, consider this: supporting 8 virtual CPUs in a partition is not the same as supporting 8 physical cores. A look at a Fujitsu SAP SD 2-tier benchmark on an Intel Xeon multi-core (Nehalem-EP) systems demonstrated that an 8-core Fujitsu system running the benchmark as an 8-virtual CPU partition only achieved around 60% of the benchmark user result as the same system (but with only half of the memory). This is partially because the virtualization software sees threads, not cores — so the 8 virtual CPU limitation means that the application was only using 8 threads.

> ***What this benchmark indicates is that the maximum partition size for a single application running on a Xeon multi-core is much less than 8 virtual CPUs might imply. This is a major difference between POWER architecture and the new Xeon multi-cores — and it serves to illustrate how POWER's advanced virtualization facilities give POWER buyers better value (from a virtualization perspective) when compared to Xeon multi-cores.***

Virtualization Prioritization

POWER Systems have the ability to spin-up large databases in virtualized partitions to deal with peak loads. Due to virtualization restrictions, however, x86 servers often need to seek database access from discrete, often under-configured database servers (under-configured in order to leave headroom for peak processing periods). As a result of having to access data elsewhere, applications have to request data from remote sources (leading to potential latency issues and performance issues as database processing becomes input/output bound).

Memory Management

The way in which memory is managed — and the amount of memory that can be managed — also differs greatly between x86 architectures and Power Systems. An IBM Power 595 System, for instance, can support up to 64 gigabytes of memory to application/database processing, as compared with 16 gigabytes per core on x86 architectures. And memory capacity is just the start of Power Systems advantage over current x86 systems designs. Power Systems offer more memory per core than x86; more memory bandwidth per core; more I/O bandwidth per core; and more cache per than x86.

> ***As a result, Power Systems can support more workload per core, thus achieving higher utilization and greater consolidation then current x86 systems designs.***

Summary Observations

With the release of its Becton-class 8-core processors in 2010, Intel is about to change the dynamics in the server marketplace. This x86-based server core is expected to pack enough processing power to challenge IBM's POWER Systems — and even (someday) compete with mainframes.

As these new Intel servers gain in popularity, *Clabby Analytics* expects two things to happen:

1. Sun SPARC design will collapse; and,
2. Intel's own Itanium microprocessors will be marginalized (and instead become "specialty" processors).

As this consolidation takes place, the server market will bifurcate:

- Dell and Hewlett-Packard (HP) will become homogeneous x86 shops.
- IBM will continue to offer both homogeneous as well as heterogeneous systems solutions. IBM will:
    - Compete head-to-head in the x86 market with Dell and HP. This competition will continue to pit IBM's x86 brand (System x) and its corresponding ecosystem against Dell and HP counterparts.

- Compete directly against x86 architectures with its POWER Systems and mainframe platforms. And,
- Blend all of its systems architectures together and manage them as a heterogeneous cloud environment.

IBM will do this because it believes that one type of processor does not do all jobs well. Accordingly, IBM will continue to offer three processor/system choices to address all workloads optimally.

When IBM competes head-to-head with other x86 server makers, IBM intends to offer the premier x86-based servers in the industry.

When IBM competes directly against x86 servers with Power Systems, it will do so on the basis of superior microprocessor functionality, highly advanced systems designs — and especially on the basis of virtualization superiority. IBM's Power Systems allow the resources of entire systems to be virtualized and exploited based on workload priorities — whereas x86 architectures are not capable of being virtualized to a comparative extent. IBM can therefore virtualize databases as well as applications — and this translates into better resource utilization, better performance, and a better return-on-investment for Power Systems customers when compared to x86 architecture.

Clabby Analytics expects the server market to bifurcate into vendors that focus primarily on x86 solutions — and a single vendor (IBM) that focuses on both x86 solutions as well as heterogeneous solutions. IBM will be able to build impressive systems designs by leveraging its advanced engineering designs into its POWER and x86 offerings. And IBM will be able to leverage its advanced software portfolio (and its unique virtualization designs) to further separate its systems offerings from those of its remaining x86 competitors. In the end, a very healthy competitive environment will have developed around three microprocessor designs — and this environment will promote advanced systems designs that will benefit the entire IT community.

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