TRENDS

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Buying Criteria For Choosing x64 Servers

by Brad Day

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Buying Criteria For Choosing x64 Servers

Selecting Systems Built On Intel EM64T And AMD Opteron

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EXECUTIVE SUMMARY

During the past year, Linux and open source applications drove the sales of x64 servers based on Advanced Micro Devices' Opteron micro-architecture and, more recently, on Intel "Nocona" processors with EM64T. Now, Microsoft has released its new 64-bit server version of Windows to take advantage of the larger volume server market optimized for both Opteron and EM64T processor technologies. In the server arena, however, CTOs and CIOs investing in x64 servers must address the following selection criteria: picking suitable 64-bit applications targets; measuring 64-bit performance with a variety of reliable benchmarks; understanding the resulting price/performance payoff; realizing the importance of supporting a wide variety of strategic operating systems; and finally, securing useful customer references as proof points before commencing a large-scale adoption of x64-based systems deployment.

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NOTES & RESOURCES

Forrester interviewed AMD, Intel, and Microsoft technical and product managers as well as CIOs, CTOs, and directors of server operations through the ongoing client inquiry process.

Related Research Documents

"Unraveling The 64-Bit Battle"
February 1, 2005, Trends

"Firms Stay The Course On Server Technologies"
July 14, 2004, Trends

"Firms Plan To Maintain Windows, Add Linux OS"
June 18, 2004, Trends

SELECTION CRITERIA FOR X64 SERVER PLATFORMS

When Microsoft announced that it would build native 64-bit versions of Windows to support AMD's x86, 64-bit Opteron, and Athlon64 processors, it put AMD back in the game. Intel responded with its own 64-bit answer to Opteron by releasing the Extended Memory 64 Technology (EM64T). As we move through 2005, Intel and AMD are poised to battle it out once again, but now in the 64-bit x86 server market, known as the "x64 server" market.

In less than two years, AMD has achieved some major server design wins in the blades, 2-processor, and 4-processor server segments. More recently, the company's successful launch of its dual-core processor offerings resulted in an even broader uptake by its tier one x86 server OEMs — HP, IBM, and Sun — which thickened their x86 server investments with a broader investment in AMD's Opteron processor. More than 50% of HP's broad set of ProLiant server model offerings carry AMD's Opteron processor technology, for instance, and Sun's entire V series (x86-based) server product line is solely dependent on its use of AMD's Opteron (and not Intel's) processors. Despite an early technology lead over Intel, culminating with AMD's recent introduction of dual-core x64 processors, AMD must now try to stay ahead of the volume x86 leader — Intel — and drive its 64-bit processors deeper into the heart of the 64-bit x64 mainstream markets.

CTOs and CIOs considering broad adoption of x64-based systems, whether using Intel's EM64T or AMD's Opteron-based servers in their enterprise, should look at five critical selection criteria:

1. **Which applications?** Investments in 64-bit architectures will target specific enterprise-class applications with heavy computing requirements like computer-aided engineering, business intelligence, and database management systems (DBMS).

2. **How much performance scalability?** CTOs will demand a high level of performance scalability as measured by a wide swath of both synthetic (e.g., TPC-C) and application-specific performance benchmark results.

3. **What's the price/performance payoff?** To justify the investment in new server architectures, customers will expect significant price/performance gains from those performance benchmark results, as compared with their existing use of both 32-bit x86 systems as well as their 64-bit traditional RISC-based server designs.

4. **Which platforms?** The feature/functionality of an operating system and its relationship to the rest of the hardware systems architecture will be a critical part of x64-based server selection. The equal, optimized, and balanced design between CPU, memory, I/O, and a specific operating system (what we refer to as a systems architecture) can still provide tremendous levels of differentiation across different systems offerings — depending on the specific applications workloads the systems architecture is required to address.

5. **Strong customer references?** Strong production class customer references must be available to add further testament that the x64 server configurations and application-specific workload sweet spots perform as promoted in real-world — i.e., enterprise-class computing — production environments.

Which Application Workloads Are Suitable For 64-Bit?

Why would customers care about 64-bits relative to their server investments in the first place? And which applications are the most attractive targets for 64-bit platforms? Answering these questions is the first step in understanding the drivers for the volume adoption in consideration for x64-based servers.

The 64-bit system architecture has been in use in Unix/RISC server products for more than a decade; Intel introduced the first generation of its 64-bit Itanium platform "Merced" in 2001. Although users can run existing 32-bit x86 applications on traditional 64-bit systems like IBM POWER and Sun Microsystem's SPARC, the price/performance ratio is often unattractive. As a result, users have confined their 64-bit application workloads to 64-bit servers optimized to meet their particular performance requirements. Now, AMD and Intel's x64 derivatives make a higher-volume, lower-cost x64 server market possible as users:

- **Want to protect their 32-bit application investments . . .** Not every application needs the memory boost of 64-bit, but the value of this new architectural enhancement is its switch-hitter appeal. Because Intel's EM64T Xeon/Pentium and AMD's Opteron chips extend the 32-bit x86 architecture, firms can either continue using current 32-bit apps or adopt a full 64-bit ecosystem that includes applications, device drivers, tools, and compilers. Furthermore, 32-bit apps running on an x86-based Opteron or EM64T server system with a 32-bit OS will get a modest performance boost over running the same applications on previous-generation 32-bit x86 systems.

- **. . . and clamor for significantly better application performance.** The 64-bit architecture offers up to 1 TB of physical addressable memory — that's an enormous improvement on the 4 GB addressable memory in today's 32-bit processor server-side designs. This additional capacity allows compute- and data-intensive apps to store vast amounts of data in the server's main memory and avoid the performance penalty of swapping data back and forth between main memory and the hard disk.

In addition, the specific applications that can take advantage of 64-bit applications, OS, and server platforms are typically data-intensive application workloads, such as computer-aided engineering (CAE), business analytics, and databases. These are the core application sets that will drive 64-bit adoption. All applications will generally fall into one of four application workload scenarios, with varying degrees of need for running a full 64-bit computing environment:

1. **Always use a 32-bit stack.** Today, 32-bit Intel Xeon-based x86 servers remain the most cost-effective technology for running generally lower-priced 32-bit infrastructure software like Web servers and file-and-print servers. Also, the vast majority of client-side apps — such as office productivity suites — don't need the performance boost offered through extended memory. Therefore, most general business PC users will stick with 32-bit applications without worrying about the processor architecture. However, with both Intel and AMD focusing all their PC processor R&D efforts on 64-bit, it is reasonable to assume that most PC buyers in 2006 will be buying 64-bit machines regardless of whether their OS and apps are 64-bit.

2. **Use 64-bit processors to run all 32-bit software.** AMD and Intel's near-term road maps point to an all-64-bit processor future for both chipmakers. Today, infrastructure applications like DHCP servers and domain controllers largely operate satisfactorily as 32-bit. However, the apps will scale and perform better with a 64-bit OS and processor combination under the hood.

3. **Stick with all-64-bit for highest linear scalability on Unix/RISC and Itanium 2.** Unix users will continue to run high-performance technical computing (HPTC) applications and complex transactional and DBMS-intensive applications on 64-bit Unix/RISC systems like Sun's SPARC and IBM's POWER5-based systems, as well as on Intel Itanium 2. These applications have complex transactional and data analytics, large data sets, heavy processing loads, and require a full complement of many 64-bit optimized feature sets (e.g., 64-bit hardware, OS, drivers, compilers, and software development tools). While the introduction of the Linux 2.6 kernel closes the feature/functionality gap between Unix and Linux, customers will still lean toward Unix on RISC alternatives — most notably, on POWER5 and Itanium 2 — for high-end, heavy-lifting applications that require maximum symmetric multiprocessing (SMP)-based performance scalability thresholds; these systems can provide near-linear scalability well beyond 32-processor systems complexes.

4. **Move 64-bit apps, currently supported on 64-bit RISC systems, to x64-based server platforms.** Throughout 2005, new apps for 64-bit Solaris and Linux, combined with reliable 2- and 4-processor multicore designs for x86 server, will make new 64-bit x64 server deployments possible and affordable. Microsoft has pushed hard to develop tools, compilers, and drivers ahead of its upcoming partner summit to entice those ISVs that optimized their 64-bit applications on Linux and Unix/RISC systems. The decade of Unix/RISC ISV courtship has resulted in more than 10,000 horizontal and vertical market applications. Forrester estimates that by the end of June 2005, Microsoft should have captured approximately 300 third-party application solutions available on its Windows 2003 x64 Edition, either going through final testing and pilots, or already prepared for production class volume release and distribution.

While 32-bit applications can run on x64-based servers, any volume adoption of this platform will be based on: 1) how these servers run 64-bit native applications, and 2) what the resulting price differential will be when compared to other 32-bit x86-based platforms. In addition, application

scalability range of performance has to be as good as or better than existing 64-bit platforms (e.g., when compared with other existing 64-bit optimized platforms, such as HP's PA-RISC, Itanium 2, Sun's SPARC, or IBM's POWER-based server alternatives). Also, the price for that given applications performance range has to be significantly lower for the same — or preferably better — performance than existing 64-bit server architectures. On this point, the release of dual-core server offerings from some vendors will target this objective as these vendors start to release new performance scalability benchmarks and the resulting price/performance achieved with these dual-core systems over the next 60 to 90 days.

How Much Performance Scalability Is Needed?

When making a strategic investment in a server, it is important to understand the performance scalability range of any specific application types on a particular platform based on reliable and industry-standard benchmarks. The most reliable performance benchmarks are those that have an equal focus on CPU, memory, I/O, and the operating system performance. It is the combined collection of the components in a systems architecture that ultimately has a significant performance impact on a larger variety of application workload types. To that end, Forrester encourages IT decision-makers and system architects to insist that x64 server vendors continue their investments in a larger swath of performance benchmark types.

Enterprise systems architects should approach the availability and use of performance benchmarks as part of their decision process with two objectives in mind: Select performance benchmarks that have enough history and rigor in how they are run and audited to be useful when comparing competitive alternatives, and wherever possible, accomplish this comparison against a wider variety of benchmark types. Performance benchmark types fall into three categories:

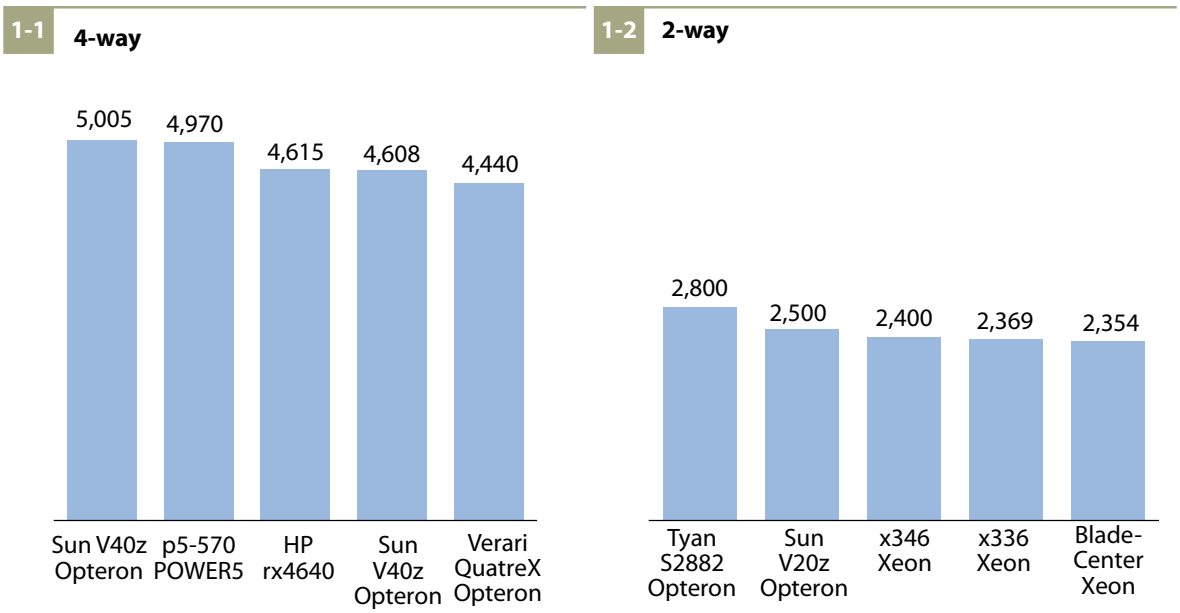
1. **Synthetic benchmarks.** Though, synthetic benchmarks like SPECint, SPECjbb2000 and SPECfp are an effective measure of systems architecture design and start to simulate applications characterization, they are often plagued by vendor tuning games.

2. **Applications-specific benchmarks.** Application specific benchmarks like TPC-C, TPC-H, Siebel, and SAP are often a better gauge of performance because they narrow the test down to the characterization of the specific application being considered and also indicate the level of commitment that the software vendor gives to a particular systems vendor, its server product and operating system. Often, these performance benchmarks also include more rigor in the way the benchmark is run and may require an independent audit of the benchmark process.

3. **Custom (customer) benchmarks.** The optimization of customer-specific workloads, developed and staged in the vendor's benchmark solutions center is the best measure of performance in the customer's own environment. This is particularly true if the application solution is either heavily based on custom coding by the customer, or the combination of synthetic and applications-specific benchmark does not a provide a clear advantage between competitive alternatives.

While the results of x64-based performance benchmarks are not expansive due to the newer release of servers based on these microprocessors, the early results are nevertheless quite impressive. Relative to comparing x64-based systems in three different applications workload environments — namely, within secure web servers environments (SPECweb99_SSL), transactional DBMS environments (TPC-C Version 5 — nonclustered results) and ERP workload characterizations (SAP SD 2-Tier) — x64-based systems from both Sun and HP have a strong applications performance position (see Figure 1 and see Figure 2 and see Figure 3).

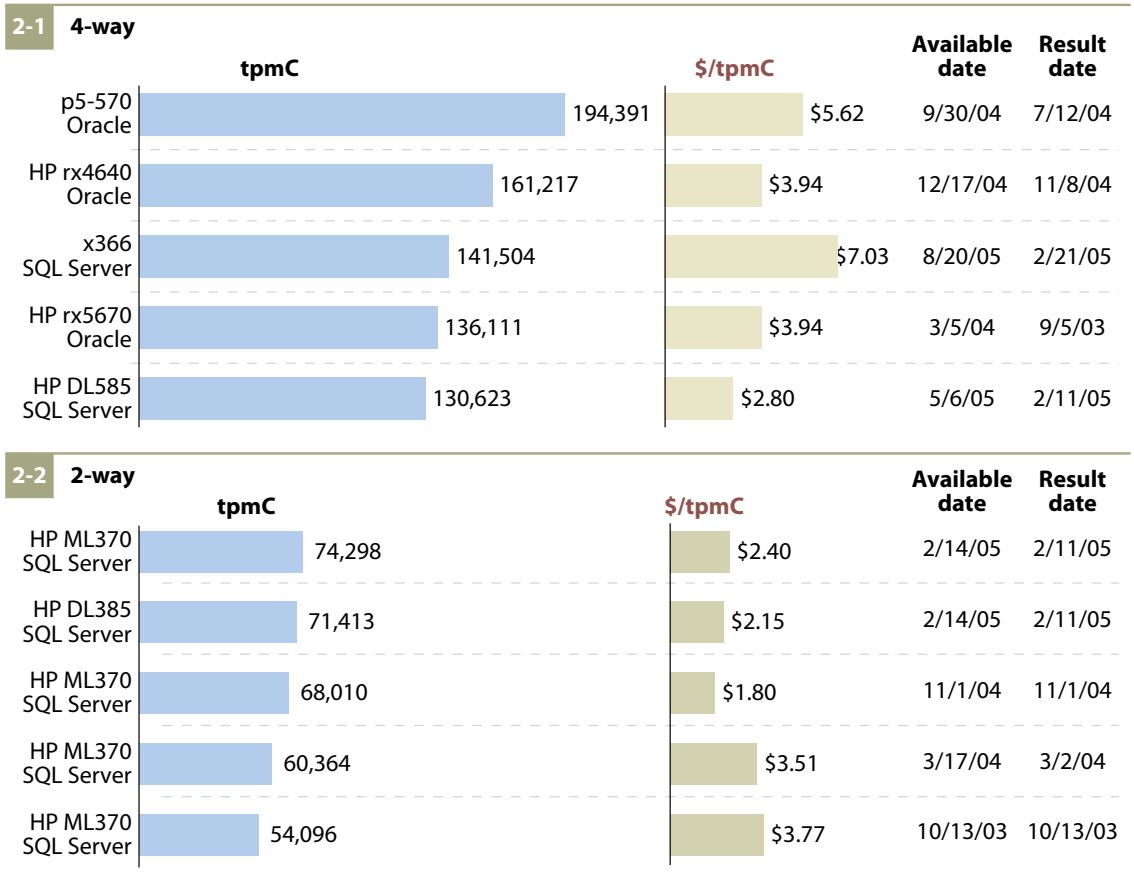
Figure 1 SPECweb99_SSL Benchmark Results (4-Way and 2-Way)



Note: All measurements indicate simultaneous secure connections
Source: www.spec.org

Source: Forrester Research, Inc.

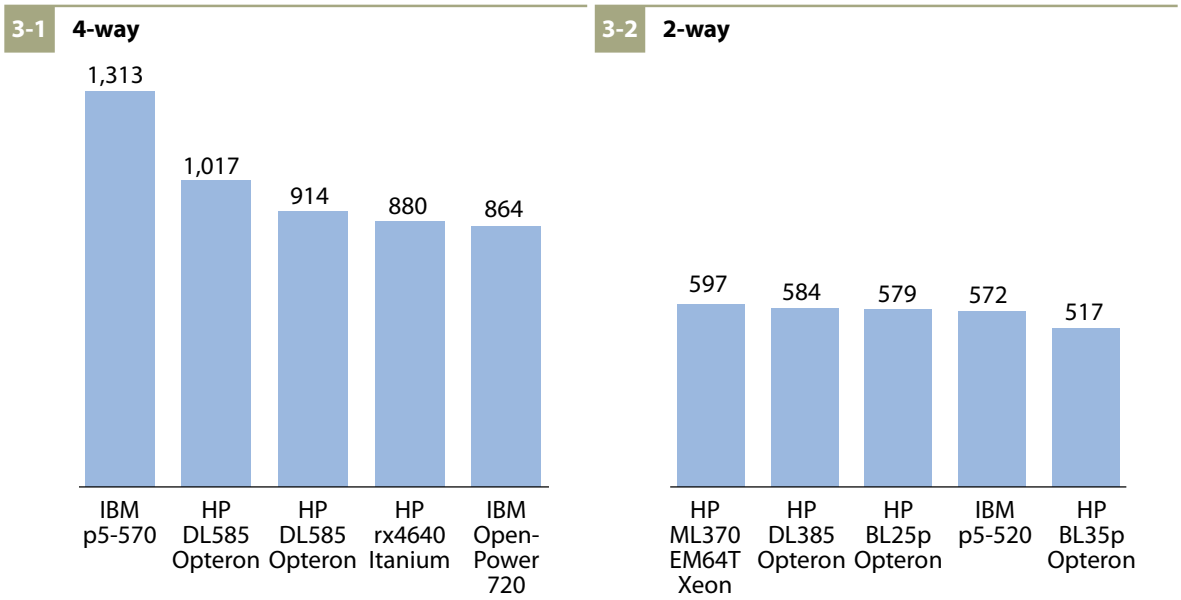
Figure 2 TPC-C Version 5 (Nonclustered)



Note: All measurements indicate tpmC and $/tpmC
Source: www.tpc.org

Source: Forrester Research, Inc.

Figure 3 SAP SD 2-Tier Benchmark Results



Note: Processor defined according to the SPEC definition of "core."
Source: www.sap.com/benchmark

Source: Forrester Research, Inc.

What Is The Price/Performance Payoff?

Once a final selection is made based on the highest applications workload scalability result, then a price for that highest performance threshold can be calculated — otherwise known as price/performance. For an x64-based server alternative to have traction, application performance results need to result in a substantially higher threshold result than competitive platforms when compared with performance results for Windows or Linux on 32-bit x86, AIX or Linux on POWER, Solaris on SPARC, HP-UX on PA-RISC, and HP-UX or Linux on Itanium 2. In addition, it should be offered at a substantially lower price for the higher performance. The x64-based platforms that garner the highest traction will need to have substantially higher applications performance thresholds at the same or lower cost of ownership.

Which Operating System Ecosystem?

The feature/functionality of an operating system and its relationship to the rest of a hardware systems architecture will be a critical part of x64-based server selection. For example, Sun's Solaris 10 feature/functionality — most notably, applications optimization tuning capabilities (D-Trace), advanced file system, virtualization technology (Containers), and granular security features (pulled from Trusted Solaris) — are all equally accessible on Sun's x64 (Opteron) server product line. This is the only one of the three Unix operating systems that can take advantage of x64-based systems. Sun's decision to take advantage of x64-based systems to lower its cost of life-cycle ownership from

a previous SPARC/Solaris product line, is in part Sun's attempt to stave off Solaris defection to Linux on other x86 server platforms.

Conversely, Linux on x64-based systems — such as Red Hat and Novell SuSe Linux distributions that both have operating systems releases based on the Linux 2.6 kernel — will start to close the feature/functionality gap with Unix/RISC systems. Both help eliminate the performance scalability gap versus Unix in the 2-way and 4-way server arena, as well as offering continued aggressive price/performance differences when compared with both Unix and Windows-based applications environments.

Which Customer References As Proof Points?

Good customer reference site due diligence should also be applied before large-scale deployments of x64-based server solutions begin. Forrester believes that strong competitive advantages still have to play out for x64-based systems to garner the higher volumes that 32-bit x86-based systems have enjoyed. In the 64-bit arena, the ability to support enterprise class "heavy-lifting" applications, such as ERP, HPTC, and transactional/DBMS applications, offering extreme applications performance scalability at the lowest possible price/performance are all critical areas that customer references need to report on to either displace or augment current 64-bit Unix and Linux RISC server system deployments.

RECOMMENDATIONS

USE PERFORMANCE BENCHMARKS WISELY WHEN CONSIDERING x64 INVESTMENTS

The marketing push and release of products in the x64 server space will hit full throttle in 2005; CTOs and CIOs will require a keen eye to separate the hype from the reality. Forrester's view is that x64 offers some compelling benefits for high-compute application environments, as well as other commercial applications workloads. However, the effective use of applications-specific performance benchmarks that measure performance and scalability in the customer's own environment, as well as the resulting price/performance for that system, remains a critical metric in determining the right server and OS choice for the applications workloads being considered.

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