Take the HP Route to Next-Generation Linux Workstations

A promising new architecture – developed jointly by Hewlett-Packard and Intel – offers dramatic performance gains using the Linux operating system.

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Performance-hungry workstation users have been eagerly awaiting the arrival of next-generation systems based on Intel® Itanium™ 2 processors. These systems, which use the EPIC (explicitly parallel instruction computing) philosophy, offer the promise of delivering dramatic performance and capacity gains over systems based on the earlier CISC (complex instruction set computing) and RISC (reduced instruction set computing) architectures.

Workstations based on Intel Itanium 2 processors are now available. These workstations are particularly well suited to complex analyses involving large data sets, including EDA (electronic design automation) simulation and verification.

Codeveloped by HP and Intel, the Intel Itanium architecture is emerging as a potential new standard for technical computing. Built-in design features provide exceptional performance for the complex computations of technical applications, 64-bit addressing, and the flexibility to support multiple operating systems – UNIX, Linux, and Windows.

The Intel Itanium architecture incorporates both hardware and software advances focused on enabling, enhancing, expressing, and exploiting parallelism by the hardware and software compilers. Some performance-enhancing aspects of the design philosophy include:

- Predication
- Speculation
- Software pipelining
- Rotating registers and other processing efficiencies
- Hardware enhancements, such as larger integer and floating point units.

The Intel Itanium architecture performs more instructions per machine cycle than conventional CISC or RISC architectures. This advance will yield outstanding performance gains well into the future, as competing architectures reach the point of diminishing returns.

Given its distinct advantages for technical computing, the Intel Itanium architecture has a great deal of momentum. More Itanium 2-based applications are becoming available, and many more are planned for release in the months ahead. Many forward-looking organizations are deploying or are actively evaluating Itanium 2-based workstations for scientific research and advanced engineering and design work. Among these organizations is the U.S. Department of Energy's Pacific Northwest National Laboratory, which is deploying an Itanium 2-based HP supercomputer running Linux.

At the same time, the Linux operating system has tremendous market momentum. Organizations running high-end computing applications, particularly EDA applications, are looking to Linux for the advantages of open-source code, including the ability to break away from the limitations of proprietary operating systems.

HP has brought together the 64-bit Linux operating system and Intel Itanium 2 processors in new workstations that meet the need for high-end computing on Linux. The result is a powerful computing combination particularly helpful for designers, engineers, and scientists, who require big memory and faster processing.

If this description fits your organization, the issue isn't so much a question of where you are going but how you are going to get there. The good news is, if you are planning to move to the Linux operating system and Itanium-based systems, the transition doesn't have to be turbulent. With the right strategy, your migration to 64-bit Linux on Itanium 2-based workstations can take place smoothly, in a manner that allows the OS transition to occur independently of the hardware transition.

Making the Transition

If the applications you need aren't yet available on 64-bit Linux and Itanium 2-based systems, you can begin your transition by using the best of what's available today – including IA-32 (Intel 32-bit architecture – Pentium 4, Xeon) and PA-RISC (precision architecture – reduced instruction set computing) systems.

Running Linux on IA-32 systems makes sense for work that is completed early in the design process and for smaller design tasks that don't require a large amount of memory. A 32-bit system can typically support up to 4 GB of memory. Moving small design tasks to 32-bit Linux leaves you positioned to make a smoother transition to 64-bit Linux on Itanium 2-based systems because you're staying on Linux all the way.

In general, IA-32 applications can be run unmodified on Itanium 2-based workstations. This is also true of IA-32 Linux applications, but with caveats: The 32-bit Linux applications will tend to run slowly on Itanium 2-based systems, and they can't take advantage of the extended capacity of a 64-bit architecture. Nevertheless, in transitioning to Itanium 2-based systems, it may be useful to deploy your IA-32 Linux applications on your Itanium 2-based systems first and later modify them to take advantage of the Intel Itanium architecture.

To get the full benefits of the Intel Itanium architecture, your IA-32 Linux applications should be compiled natively for Intel Itanium 2 systems. This is a two-step process. The 32-bit applications must first be converted to 64-bit and then recompiled for the Intel Itanium architecture. The 32-bit to 64-bit conversion process will typically include a significant amount of programming work, including code changes to address programming practices that worked on a 32-bit architecture but won't work on a 64-bit architecture. Once the code is 64-bit ready, IA-32 software can then be recompiled for the Intel Itanium architecture. Extracting maximum performance on Itanium 2-based systems is made easier by advanced compilers, which are designed to take maximum advantage of the Intel Itanium architecture.

Once your Linux applications are 64-bit ready, they should be capable of being compiled to run on either IA-32 or Itanium 2-based systems. This means there is no need to maintain separate 32-bit and 64-bit source code streams, because the same source code should work for both architectures. This principle has been tested widely in actual implementations. Today, Linux distributions include thousands of open-source packages that have a single set of source code for applications to be built and run on IA-32-based and Itanium-based workstations, as well as other architectures.

The HP-UX Gateway to Itanium-Based Systems

A good deal of higher-end design and engineering work requires far more memory than an IA-32 system can address. If you've run EDA simulation and verification applications on IA-32 systems, chances are you've run up against the architecture's typical 4 GB memory limitation. For work requiring more than 4 MB, heavier work with large data sets is ideally suited for PA-RISC systems and their higher memory capacities. A dual-processor HP-UX (Unix) PA-RISC workstation can hold up to 16 GB of memory.

The ability of the Intel Itanium architecture to work with multiple operating systems makes for an easy transition from HP-UX to HP's Itanium 2-based workstations. The Intel Itanium architecture already supports HP-UX, so applications running on 64-bit HP-UX 11 systems can easily be migrated to the Intel Itanium 2 platform.

If you are a current PA-RISC customer, you may already be using an operating system and hardware that is ready for the Intel Itanium 2 processor. The 64-bit HP-UX 11 operating system, designed to serve as a gateway to the Intel Itanium architecture, offers binary compatibility with Itanium-based systems. This makes it relatively straightforward to move an HP-UX 11 application from a PA-RISC workstation to an HP Itanium 2-based workstation.

HP-UX, used in concert with the Intel Itanium architecture, has an emulation mode that allows it to execute PA-RISC binaries – which means that HP-UX applications don't necessarily have to be recompiled to run on Itanium 2-based systems. Performance is better, however, if PA-RISC applications are recompiled for the Intel Itanium architecture. So, if top performance is essential, you will want to take this extra step. The process is fairly straightforward with HP-UX applications because you don't have to convert the source code to be 64-bit compliant – HP-UX supports both 32-bit and 64-bit programming models, which means your 32-bit applications are already 64-bit ready.

Migrating on Your Schedule

Once your HP-UX applications are running on the new Itanium 2-based system, you can either remain on HP-UX or, if your computing strategy calls for moving to Linux, you can migrate your applications to Linux when the time is right for your organization.

Because Linux for Itanium 2-based systems supports only 64-bit applications, migrating HP-UX applications to 64-bit Linux is more involved than the relatively easy task of moving HP-UX applications to Itanium 2-based systems. This means that (just as with 32-bit Linux applications) 32-bit HP-UX applications running on Itanium 2-based systems must first be converted to 64-bit, and then recompiled for Linux. But if this is your strategic direction, there's no urgency to make this transition. HP-UX applications will continue to give you all the benefits of Itanium-based systems until you are ready to port your applications to Linux.

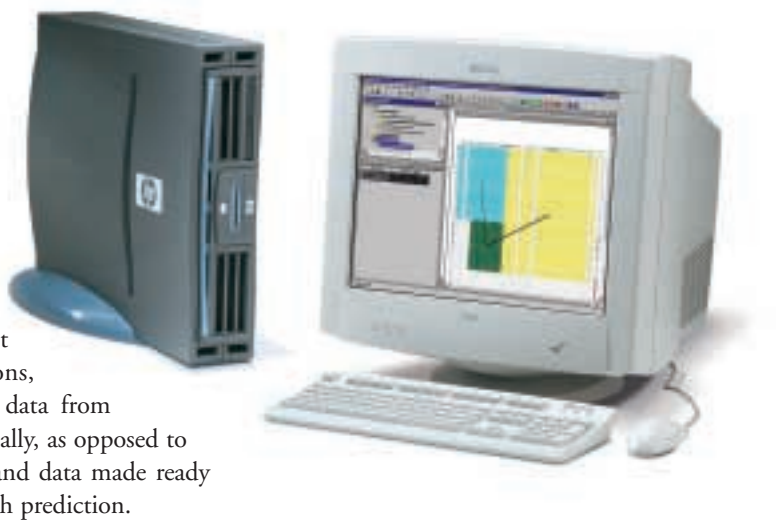
Further, HP-UX on Itanium 2-based systems supports a Linux ABI (application binary interface) that will allow you to run Linux Itanium applications under HP-UX – yet another path to the future.

You can follow any of these paths to transition your operating system to Linux, independent of your hardware transition to the Intel Itanium architecture. This gives you the best of all worlds – the use of Linux on lower-cost IA-32 systems for as long as they make sense; the proven performance of HP-UX for demanding analysis, engineering, and design work; and a clear path to Itanium-based systems. When you are satisfied that the applications you need are available on Itanium, you can begin your hardware transition.

Is HP the Right Choice For You?

HP's Itanium-based workstations take maximum advantage of the Intel Itanium architecture. In particular, the HP Chipset zx1 greatly extends the gains made possible by the Intel Itanium architecture. This high-bandwidth, low-latency chipset enables the Intel Itanium 2 processor better than any other system.

The HP Chipset zx1 is at the heart of the HP Workstation zx6000, the performance leader among 64-bit workstations. This one-way or two-way Itanium 2-based workstation surpasses all systems for floating point performance and surpasses all other 64-bit systems for integer performance. Its low latency is extremely important for EDA applications, which tend to access data from main memory continually, as opposed to using cache memory and data made ready by pre-fetch and branch prediction.



On the floating-point engine measure, the HP Workstation zx6000 achieved the world's fastest SPECfpbase_2000 result of 1,356, according to the Standard Performance Evaluation Corporation (SPEC). This score for the HP workstation is 13 percent higher than IBM's most powerful CPU, the Power4 at 1.3 GHz, with a SPECfp_base2000 score of 1,202. The HP workstation is also 1.9 times faster than the Sun Blade 2000 (UltraSPARC III 1050 MHz copper), with a SPECfp_base2000 score of 701. (For more detailed benchmark information, see *www.spec.org*.)

The HP Workstation zx6000 delivers the pinnacle of workstation 64-bit performance for scientists, engineers, designers, and others running memory-hungry applications. It can be equipped with up to two 1 GHz Intel Itanium 2 processors loaded with 3 MB of on-chip L3 cache and as much as 12 GB of RAM, increasing to 24 GB when 2 GB DIMMs become available.

At the same time, the HP zx6000 is flexible. In addition to providing a choice of 64-bit Linux, HP-UX, or Windows, it can be deployed as part of a racked computing solution or as a single-user system. Moreover, its use model can change over time. An HP zx6000 might be deployed initially in a cluster node running Linux and later redeployed at the deskside running Windows. In racked implementations, the HP zx6000 offers extraordinary compute density – 20 workstations can be placed in a 2-meter rack for an astounding 160 GFLOPS (GigaFLOPS) of potential power.

Conclusion

Factors like those mentioned above make the HP zx6000 workstation a powerful choice for electronic design, computer-aided engineering, scientific research, life sciences, and digital content creation and rendering. It also provides an ideal software development platform for Symmetric MultiProcessor-capable code.

These same factors help make HP an optimal choice for organizations transitioning to Itanium 2-based workstations and the Linux operating system for EDA work. With support for 64-bit Linux, the fastest floating-point performance, and the lowest-cost big-memory solution, HP's Itanium 2-based workstations offer clear advantages for EDA customers.

If you are constrained by memory limits or you need exceptional price performance for 64-bit computing on Linux, HP has a solution designed for you – and a clear strategy for getting you there. And to enable a smooth transition, HP offers a full suite of services spanning your planning, porting and migration, support, and education needs.

To discuss your specific needs and transition issues, contact your HP sales representative. To find an HP sales representative online, visit *www.hp.com/go/workstationrep*.

To learn more about HP Workstations, including the Itanium 2-based systems, visit *www.hp.com/go/workstations*.