

Success Story

Intel® Software Partner Program

Migration Specialties International, Inc.



"You can find an Alpha that will fit any niche you care to name, and they were installed accordingly. Now that the hardware isn't being made anymore, people need an alternative approach, and we are meeting that need."*

- Bruce Claremont,
Software Preservationist,
Migration Specialties International

Keeping Great Legacies Alive

Migration Specialties emulates aging Alpha* hardware to migrate solutions onto new servers



**MIGRATION
SPECIALTIES**

CHALLENGE

Provide the means for existing software solutions built for Alpha* hardware to function on new machines, even though servers based on the Alpha architecture are no longer available.

SOLUTION

Migration Specialties International provides products that emulate Alpha hardware using advanced software technology and virtualization on Intel® platforms.

- **Avanti*** is a production environment that makes Intel® architecture appear identical to Alpha hardware for the rest of the solution.
- **FreeAXP*** is a performance- and capacity-limited version, provided as a technology demonstrator to customers.

CUSTOMER BENEFIT

Customers are able to continue using their existing Alpha solutions on new, dependable, power-efficient platforms without the need to re-certify the architecture or retrain personnel.

More

Learn more: www.intel.com/partner

PROOF POINT

Driving Up Performance with Tools from Intel

Emulating a completely different hardware environment in software is complex and doing so while maintaining acceptable performance just adds to that complexity.

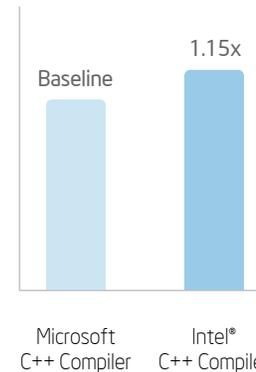
Migration Specialties engineers place a lot of value on that performance so it is vital that they highly optimize their code for the features and capabilities of Intel® platforms.

As part of their tuning efforts to make the codebase behind Avanti* and FreeAXP* run as fast as possible, they used the Intel® C++ Compiler and Intel® VTune™ Performance Analyzer, which allowed them to achieve excellent results:

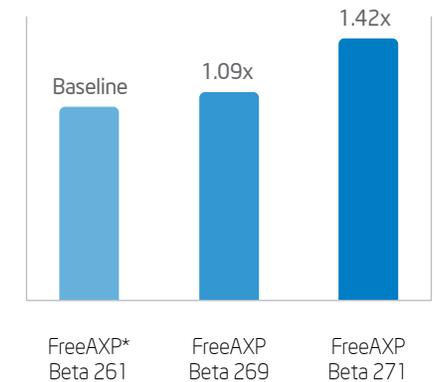
- **Compiler optimizations.** The Intel C++ Compiler helped the team improve performance by a factor of 1.15x, and Profile Guided Optimization has helped them do even better.¹
- **Tuning with Intel VTune tools.** The Intel VTune environment enabled them to achieve a 1.42x performance improvement to the FreeAXP beta over the course of a week.¹

Proof points such as these are an important aspect of assuring customers that Avanti and FreeAXP can handle the demands traditionally placed on Alpha hardware.

Performance Improvement Using Intel® C++ Compiler



Performance Improvement in One Week Using Intel® VTune™ Performance Analyzer



Intel® Software Development Products helps Migration Specialties dramatically improve performance.¹

The Ongoing Role of Alpha* Architecture

With the launch of the DECchip* 21064 processor in 1992,² Digital Equipment Corporation introduced the Alpha* architecture. This RISC design was the first commercially available native 64-bit architecture on the market, and Alpha set the standard for 64-bit computing for the next decade.

The tremendous success of the Alpha line stemmed from its class-leading performance. Primarily running the VMS* (later OpenVMS*) and Tru64* UNIX* (formerly Digital UNIX and DEC OSF/1*) operating systems, Alpha hardware continued to be widely deployed in a variety of implementations.

Compaq Computer gained ownership of the Alpha architecture when the company acquired Digital Equipment Corporation in 1998. The merger between Compaq and Hewlett-Packard (HP) in 2002 eventually led to ceasing production of Alpha equipment in 2007 in favor of an emphasis on servers based on Intel® Itanium® processors, although a very large install base of Alpha systems remains.

A Workhorse for Many Seasons

The most pronounced illustration of the Alpha architecture's value and impact is the breadth of its implementation. During the 15 or so years it was in production, equipment based on Alpha processors was deployed into every corner of the world's commercial

and public-sector computing infrastructure, including the following areas:

- **Servers and large-scale computing.** Powerful servers built on Alpha processors were widely deployed for business and technical use, scaling up to Cray supercomputers and mainframe-class machines.
- **Industrial and embedded implementations.** Applications for industrial automation are a common use for Alpha architecture, including on factory floors and in computerized machine tools and military equipment.
- **Workstations and personal computers.** Alpha-based machines found widespread use in design automation and other high-end workstation implementations and further demonstrated their flexibility in desktop computers and, infrequently, on laptops.

A measure of the dependability of the Alpha architecture is its large deployment in systems and solutions that were intended to last for many years. With the discontinuation in production of Alpha architecture-based hardware, customers have increasing interest in emulation of that equipment, as an alternative to wholesale replacement of the entire solution. Particularly as budgets across industries become tighter, retaining the viable parts of those solutions makes clear economic sense.

The Transition to Software Emulation

Recognizing the value of providing support for Alpha architecture-based solutions on up-to-date hardware, Migration Specialties International produces technology that bridges that gap through software emulation of Alpha equipment.

The FreeAXP* and Avanti* products from Migration Specialties allow new equipment to be used as a drop-in replacement that appears to the software as an exact replica of the hardware architecture on which it was originally installed. That capability enables migration to Intel® architecture-based systems to take place with minimal disruption, avoiding significant porting and integration effort that would otherwise be required.

- **Replace control systems.** The lifespan of industrial machinery and similar capital equipment is typically measured in decades, while the computer-based systems built to control it often must be replaced within about five years.
- **Preserve binary compatibility.** Because an image taken from existing Alpha infrastructure runs without modification using Free AXP or Avanti, migrations can occur using existing operating systems and applications, without access to source code.
- **Retain existing solutions.** Continuing to use software and processes that meet ongoing requirements, avoiding integration of new infrastructure, and retraining personnel can avoid substantial expense.
- **Obtain new hardware efficiencies.** The latest systems based on Intel architecture deliver excellent energy-efficient performance³ that can dramatically reduce operating costs.

As Alpha-based hardware nears the end of its life, organizations are faced with the reality that new hardware is not available, and many see refurbished systems as a

substandard choice. Those that choose to dramatically reduce the impact of this transition using software emulation technology will benefit from Migration Specialties' FreeAXP or Avanti.

Whereas moving software applications to a different architecture is typically difficult and expensive, FreeAXP and Avanti simplify the process and dramatically reduce migration cost. Moreover, end-users see no application changes, and organizations continue existing arrangements for software support.

Meeting Migration Challenges

Creating the software emulation layer that underlies Avanti and FreeAXP is a challenging undertaking, and meeting the needs of a well-established architecture presents demands on a number of fronts.

"Performance is a key consideration for our customers. Alpha systems are fast, and anything you use in their place has to be fast, as well. We spend a lot of energy coaxing every bit of performance from the Intel® platforms, and Intel's tools are an important part of the equation. As Intel advances both its hardware and software technologies, we move forward, as well."

- Bruce Claremont,
Software Preservationist,
Migration Specialties International

Migration Specialties' core competencies are well suited to meeting the following challenges:

- **Intrinsic complexity of 64-bit software.** In general, programming for 64-bit architectures is more complex than equivalent tasks in a 32-bit environment.
- **Translation between foreign architectures.** Significant aspects of the Alpha architecture must be emulated in software, including PAL mode, which is the equivalent to a fifth privilege ring in addition to the four on Intel architecture.
- **Demanding performance requirements.** Avanti and FreeAXP must be highly tuned for performance, despite the complexity of 64-bit programming and the overhead of emulating hardware features in software.

Migration Specialties has used its expertise with porting and migrating systems between different types of hardware to produce a robust emulation environment. Currently, Avanti and FreeAXP are able to replace lower-end Alpha hardware such as DEC 3000 and AlphaServer 400. As Migration Specialties continues to refine its offerings and adopt more powerful Intel platforms, it expects to emulate progressively higher-end Alpha hardware. Ongoing optimization to obtain the best performance possible is an important part of that effort.

Tuning for Performance

As the development team continues to pursue higher levels of performance, they are also developing their relationships with the Intel® Software Partner Program. The program helped Migration Specialties

obtain discounts on the Intel® C++ Compiler, for example. Intel also provided technical assistance in the use of the Intel® VTune™ Performance Analyzer that was instrumental in meeting the team's performance goals during the beta phase of code development.

Complementing that direct assistance, developers also took advantage of white papers and forums through the Intel® Software Network. In addition to providing general architecture and tuning advice, for example, those resources helped them work through integration issues that arose during the tuning process associated with using tools from multiple vendors. The project also benefited greatly from using the following Intel® tools (also see the sidebar, "Driving Up Performance With Tools from Intel®"):

- **Intel C++ Compiler.** Automatic optimizations using the compiler helped improve the code, and using profile-guided optimization, the team ran Alpha workloads on the emulator as the compiler tuned it, which improved performance tremendously.
- **Intel VTune Performance Analyzer.** Call graph profiling allowed the team to focus on specific functions to optimize performance, and Intel® Thread Profiler helped them identify cross-threading locks that were causing performance stalls so they could quickly isolate trouble spots and improve code performance.

These tuning efforts were instrumental in positioning Alpha workloads to take advantage of the strengths inherent in Intel architecture.

Taking Advantage of Multicore Intel® Architecture

During the early stages of running its emulation environment on Intel platforms, Migration Specialties found that taking advantage of some of the available benefits didn't require any additional effort. For example, the large L2 caches available in Intel processors proved beneficial. The team tested performance on systems that were similar except that one had a 4 MB L2 cache while the other had 6 MB, and they found that the extra 2 MB of cache increased performance by approximately 15 percent.¹

Because Alpha processors are single-core, the critical path running on the Intel processor is the emulation of the central processor in the Alpha server, which can run on only one core of the Intel architecture-based system.

To utilize the other available cores, FreeAXP and Avanti use separate threads that emulate other hardware components of the Alpha platform. For example, threads are used to emulate hard disks, disk controllers, network interface cards, chipset components, and so on. Thus, while overall performance tends to be bound by the critical path associated with processor emulation, the environment as a whole nevertheless benefits from multicore Intel architecture.

In the future, as FreeAXP and Avanti emulate multi-processor Alpha systems, the team will assign the additional processors and other hardware components of those more complex systems to separate threads. That evolution will help the emulation environment to scale as it takes advantage of higher core counts in future processors and larger-scale Intel platforms.

Looking Ahead, to Sustainable Alpha and Beyond

While Intel Itanium processor-based systems have taken the place of Alpha-based ones in the HP product line, porting the applications that customers run on Alpha systems to the Intel Itanium architecture can be complex and costly. Migration Specialties is working to address that issue by enabling Alpha software to run natively on Intel architecture, supported by a complete set of offerings, which include:

- **Software sales.** End-customers can purchase Avanti (and obtain FreeAXP for demonstration and verification purposes) direct from Migration Specialties or through value-added resellers.
- **Turnkey installation.** Migration Specialties offers installation, porting, and configuration services that draw on

its knowledge of Alpha hardware and experience mapping it within the emulated Alpha environment.

- **Support and consulting services.** Long-term support of the emulated hardware environment and solutions that run on it are also available from Migration Specialties, helping simplify ongoing operations for customers.

Migration Specialties intends to expand its line of emulation products to include the VAX* architecture, Alpha's predecessor. In the future that expansion could continue to include HP3000*, HP9000*, and IBM AS/400* systems. As time goes on, a broader range of legacy customer implementations will benefit from modern hardware, improving reliability, performance, and energy efficiency for lower costs as the past becomes the future.

About the Intel® Software Partner Program

The Intel® Software Partner Program provides a framework for collaborative solution development around Intel® architecture. From business planning and product development to marketing and sales, the program helps to drive increased business success and market opportunities. Learn more at www.intel.com/partner.

Success Story by:



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Migration Specialties
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¹ Performance reported by Migration Specialties International.

² The number "21064" comprises three parts: "21" refers to the 21st century, "0" indicates the beginning of the series, and "64" signifies 64-bit architecture.

³ <http://www.intel.com/technology/eep/>.

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