Technical Articles

Linux OS on the PowerPC Architecture: The Right Match for Pervasive Computing

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The Linux® operating system running on the PowerPC™ architecture offers a streamlined, high-performance platform for pervasive computing applications. This article will define the pervasive computing market space, introduce key advantages of the PowerPC architecture and discuss why the Linux operating system (OS) makes a good match for the PowerPC architecture – and thus a good match for system developers.

Beyond desktop computing

The term pervasive computing is used to describe the notion of computing capabilities embedded everywhere to help us accomplish our everyday tasks. It's the dynamic, global connection and coordination of computing devices in the home, car, office, store, bank and on the person – providing access points to information, services, and applications. It's a futuristic vision in many ways, but there is no doubt that computing today has extended well beyond the desktop and the paradigms of computing are shifting. Our cell phones and personal digital assistants (PDAs) are prime examples of how *pervasive* computing has actually become. The implementation of computing to provide various services is also dramatically changing. There are applications ranging from cluster computing to thin clients to home entertainment terminals that are providing a new set of solutions to the consumer and enterprise markets.

These types of applications require higher-performance computing elements running streamlined software often fitting into lower power budgets. The PowerPC architecture has a very strong legacy in multiple markets including consumer, networking, automotive, military and industrial. Freescale not only delivers high-performance discrete PowerPC processors, such as the G4, but we also have expertise in creating System-on-Chip (SOC) platform solutions for our customers – integrating PowerPC cores, buses, high-performance interfaces, memory controllers, security, and so on all on one chip. This enables us to tailor our processor products for specific applications. "When developing a new platform, we don't just focus on frequency at any cost, we go out to make it the best performer available for a particular market," says Dan Bouvier, Freescale's PowerPC Architecture Manager.

Through the innovations of integration come even better system performance along with cost and power savings for our customers. These characteristics are what make the PowerPC architecture also a prime candidate for service-oriented computing – such as kiosks, set-top boxes, gaming systems, and thin clients.

The pervasive computing markets will also undoubtedly benefit from the strong growth of that pervasive penguin: Linux OS. The flexibility and customization capabilities of systems based on the PowerPC architecture and Linux OS can enable innovation and accelerate the experimentation with new application form factors, thus serving as a stimulus for a number of pervasive computing markets as shown in Figure 1.

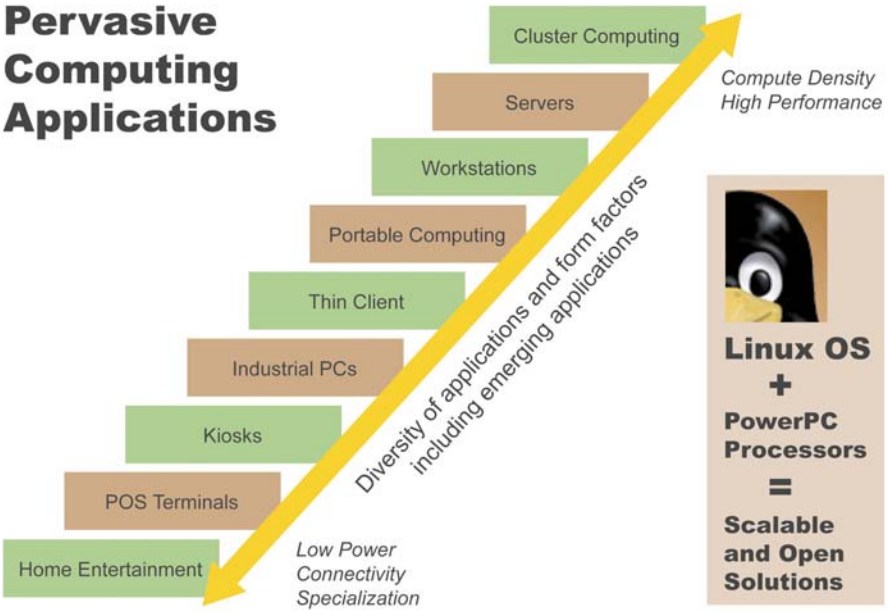

Figure 1: PowerPC and Linux Enable Scalable Performance for Pervasive Computing

A core architecture for computers, communications and consumers

The PowerPC architecture began over a decade ago as a collaboration between Motorola (now Freescale Semiconductor), IBM and Apple Computer. These companies had a goal to create a new kind of microprocessor that was not limited to computers alone. What the collaborators had in mind was a whole new processor roadmap to serve the “three Cs” – computers, communications and consumers. Read more on the history here.

In the years that have followed, the PowerPC architecture has gained strong footholds in a wide spectrum of applications from very low power embedded devices up to big compute-intensive applications. The architecture enables very scalable cores while maintaining the same instruction set from low to high. In the embedded space, PowerPC cores proliferate areas such as wireless infrastructure, WAN and enterprise routers, and automobiles. From a pure compute perspective, the PowerPC core enables applications such as mobile and desktop computers, servers, printers, and image processing.

The PowerPC architecture has been a highly managed architecture, meaning it’s well defined and very consistent throughout the entire line of products, from the first discrete PowerPC processors

operating at just 66 MHz to the latest, more integrated solutions that speed well past 1 GHz. This continuity of architectural development has been a tremendous advantage for third-party developers. They know their investments in PowerPC processor-based products are both backward- and forward compatible, and they can take advantage of future generations of PowerPC platforms without worrying about having to reinvent the wheel.

Some of the more recent processors available from Freescale include the MC7447A based on the G4 PowerPC core and the PowerQUICC™ III line (including MPC8540 and MPC8560) based on the e500 PowerPC core. In addition, Freescale disclosed its next-generation, high-performance processors based on the PowerPC architecture in the fall of 2004. These new products use the new e600 PowerPC core (a slightly enhanced G4 core architecture designed for 90nm process technology). The products include the MC7448 (pin-for-pin compatible with the MC7447A), the dual core MPC8641D processor, and the MPC8641 (the single core sister of MPC8641D).

One of the hallmarks of the Freescale G4 and e600 PowerPC cores is AltiVec™ technology, a 128-bit vector processing engine designed to accelerate a wide range of computationally intensive applications. Introduced in 1999, AltiVec technology has powered significant performance improvements across the computing, imaging, and networking industries in applications ranging from office automation to cutting-edge medical imaging technology to TCP/IP protocol stack processing. Performance benchmarks with Freescale's PowerPC G4 processors running with and without AltiVec optimizations can be found at the Embedded Microprocessor Benchmark Consortium website. With AltiVec optimizations, certain applications can experience up to a four times increase in performance.

Why Linux OS on the PowerPC architecture?

Soon after the PowerPC architecture came onto the scene, Linux OS running on the PowerPC was envisioned. Now, PowerPC Linux is a robust, time-tested, and proven solution. The Linux OS enables unparalleled flexibility and customization for pervasive computing applications. It can support a wide range of hardware – large and small. In fact, one of the advantages of PowerPC Linux is its binary compatibility. A program built for a high-end server will work equally well for a thin client.

The PowerPC architecture gives Linux developers a very credible, and in many ways better, choice for system design. The PowerPC architecture offers a balance of performance, frequency and low power and as such represents an excellent choice where flexibility, customization, and scalability are concerned. The combination of Linux and PowerPC architecture delivers an impressive platform for pervasive computing applications.

Getting started

The *Freescale PowerPC Linux Developer Connection* web site will be a good starting point for your exploration with the PowerPC architecture. You'll find information about PowerPC technologies, products, and the tools and software offered from Freescale and our alliances.

There are a number of Linux distributions that run on the PowerPC architecture. The list includes both commercial and non-commercial distributions. It is important to note also that the list of the Linux offerings is also a growing one. Here is a reference to the currently available packages:

- Debian
- Gentoo
- Yellow Dog Linux
- Mandrake
- CRUX
- Knoppix

There are various PowerPC platforms available to help you get started. Genesi supplies the Pegasos II Open Desktop Workstation that can be used to natively build Linux kernels, root file systems, and applications. This workstation leverages a PowerPC MPC7447 processor and is configured based on selected OpenFirmware (IEEE1275) with Debian, Yellow Dog Linux and MorphOS.

Freescale's Sandpoint X3 Evaluation System demonstrates the capabilities of PowerPC processors and the Tundra Tsi107™ PowerPC Host Bridge. The Sandpoint Evaluation System is the ideal platform for software development and debug, as well as for hardware development. There are various PCI Mezzanine Cards (PMCs) available for the Sandpoint system, two of which come pre-configured with Linux OS.

The Linux OS is making its mark as a low-overhead, open, cost-efficient operating system for a broad and growing range of systems. Linux OS and the PowerPC architecture can enable emerging applications moving forward as computing continues to permeate our everyday lives in new and innovative ways.

Resources

- **General Linux Information**
  - Linux Forums (http://www.linuxforums.org/)
  - Tutorials at Linux Headquarters (http://www.linuxheadquarters.com/index.shtml)
  - Help with your Linux related questions (http://www.linuxquestions.org/)
  - Linux information, tutorials, links to Linux projects (http://www.freelink.cx/)
  - PPC Zone **(**http://www.ppczone.org/modules/news/**)**

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