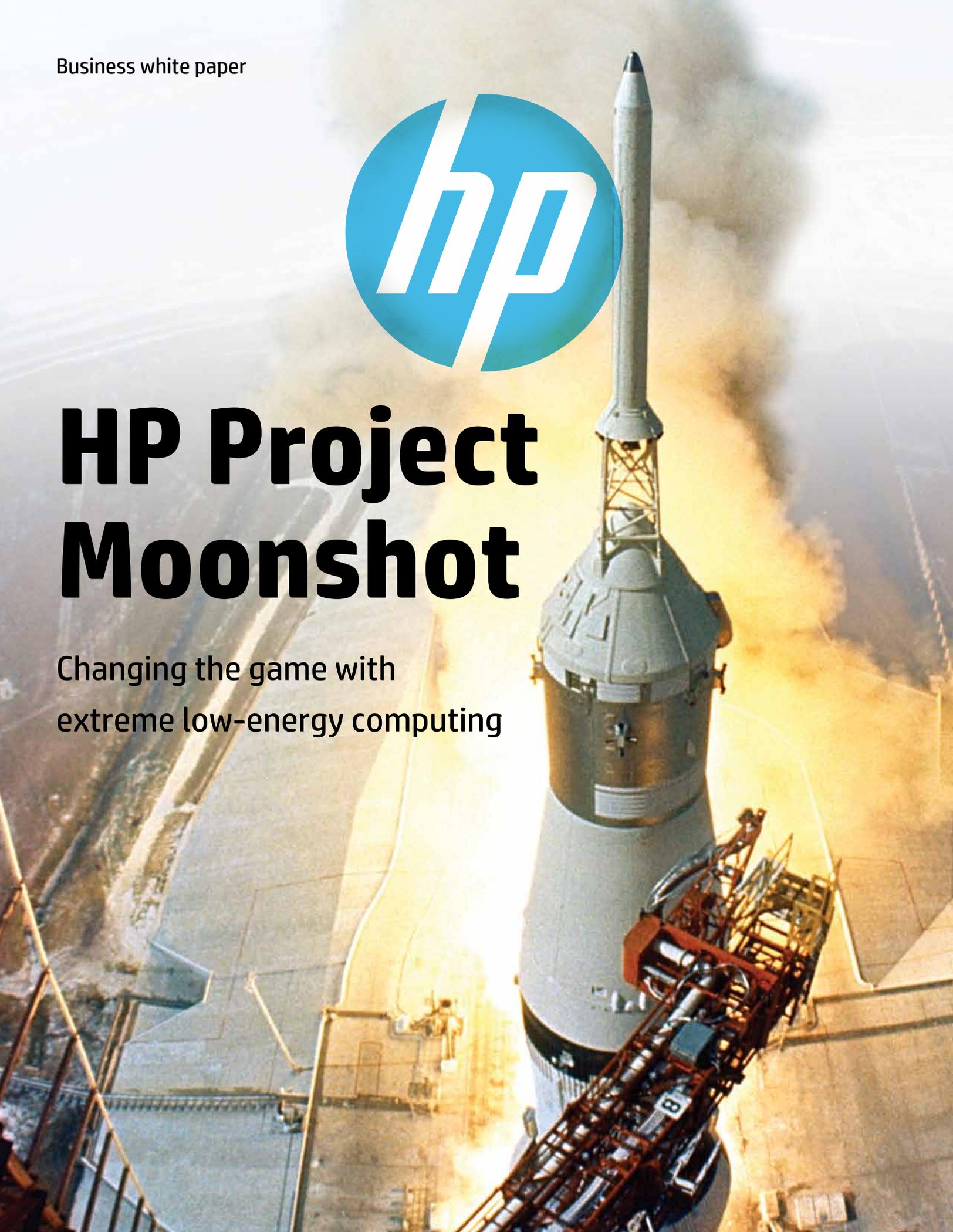


Business white paper



HP Project Moonshot

Changing the game with
extreme low-energy computing



HP Project Moonshot

In computing, progress is marked by continuous improvement punctuated with breakthrough innovations that reset the bar and establish new platforms on which the industry innovates and grows. Examples are easy to find—databases, personal computers, x86 processor architecture, 3G wireless, blade systems, virtualization. Each of these spawned an ecosystem of players that brought exciting new solutions to the marketplace enabling the next phase of a connected society. HP Project Moonshot is a holistic program comprised of breakthrough server technology using extreme low-energy processors, an industry program and Discovery Lab to enable the connected society promised by mobility and social media.

The need

Why HP Project Moonshot? Because more than two billion people now connect with each other and with businesses over the Internet,¹ many of them from mobile devices. To serve this insatiable appetite for digital content and experiences, a new generation of Internet businesses must scale their technology to match the surge in social media and e-business. IT faces soaring numbers of servers, storage, and network connections—and the energy to power them and data centers to house them.

But the Internet boom is bottlenecking in the data center. Existing server technology can't scale out fast or far enough. The energy and space needs—and the cost—overwhelm existing approaches. While we expect most traditional IT computing needs to be best served by existing server technology, this industry needs a new approach—one that enables server scale out to dramatic new levels within existing energy and space constraints.

HP Project Moonshot does that by delivering servers based on the same extreme low-energy processors used in mobile devices. They provide the same computing power in about one-tenth of the space and power of comparable x86 server scale out. But new technology is not enough. Like all computing breakthroughs, the success of extreme low-energy computing will come through the efforts of a broad array of software, compute, storage, and networking providers. And it will come in collaboration with the user organizations that most need its benefits. Project Moonshot enables all of that.

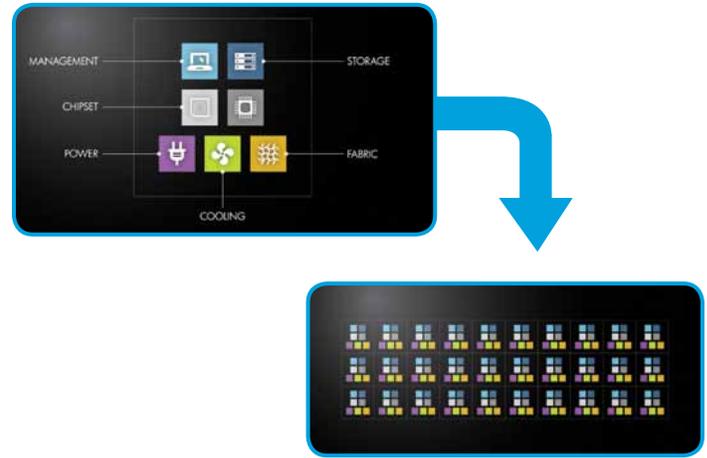
The technology

There's nothing new about extreme low-energy processors like ARM and Intel® Atom™. The phone in your purse or pocket probably contains one. But simply packing many processors together doesn't solve the problem. In traditional x86 scale out, each server has its own processor, chipset, management, storage, cooling, power, and network interface—little is shared. Complexity and cost grow with scale.

¹ Internet World Stats, <http://www.internetworldstats.com>

Figure 1

In traditional x86 server scale-out, tens of servers per rack share basically nothing. Every processor has separate, dedicated management, fabric, storage, cooling, and power elements.

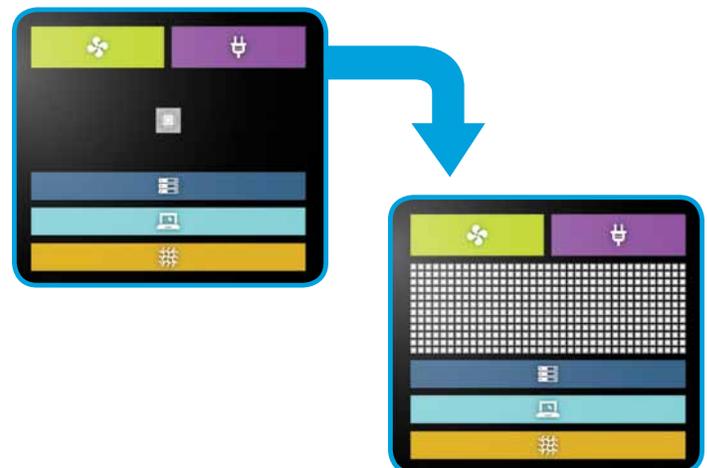


HP Project Moonshot takes a different approach. Every component above the processor level—elements like HP Smart Array RAID controllers and HP Integrated Lights Out (iLO) management—is pulled into the chassis where it is shared among all the servers. Network fabric is integrated into the system and shared to reduce cabling. We implemented the management framework at the chassis level and federated chassis management to enable a single management point for an entire rack or row.

This shared, federated approach saves energy and cost, but just as important, it enables extreme scale-out without a corresponding increase in complexity and management overhead.

Figure 2

With Project Moonshot server scale-out, thousands of servers per rack can share almost everything.

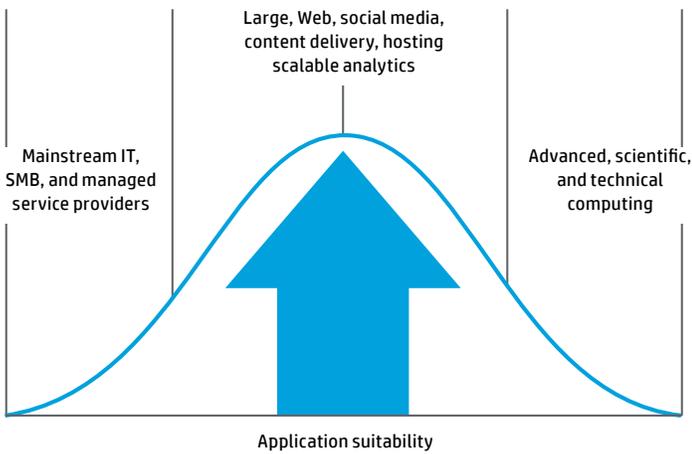


HP Project Moonshot is processor agnostic. The Redstone Development Server Platform (our first Moonshot offering, which we describe below) uses Calxeda EnergyCore ARM processors, but the architecture can accommodate x86 processors like Intel Atom and is positioned to take advantage of future processor advances.

The results

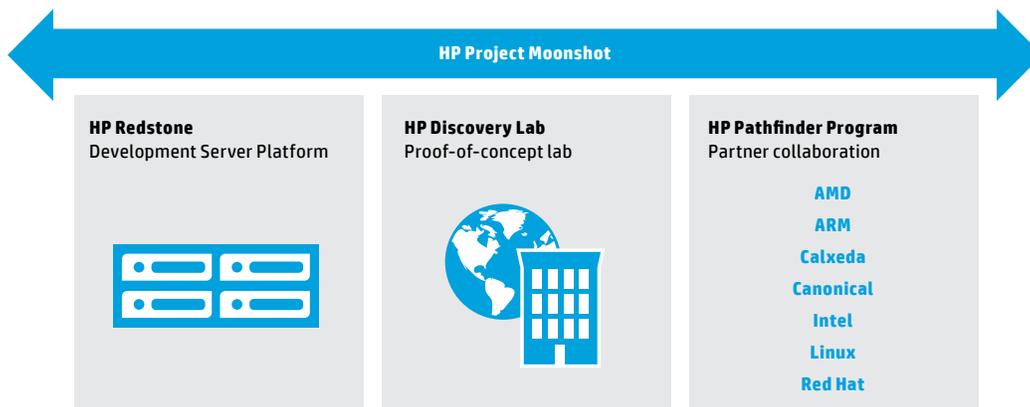
The sweet spot for extreme low-energy servers is typical Internet applications requiring “light scale-out,” where fetching and delivering data is more important than computational power. These are applications like content delivery, video services, distributed memory caching, search—the applications that drive a connected society.

Figure 3
Moonshot program application target



Performance benchmarking of these light scale-out applications underlies modeling we have done to compare energy, space, and cost for Moonshot servers to traditional x86 scale out. The modeled x86 system consists of 400 dual-socket 1U servers in 10 racks. It

Figure 4
HP Project Moonshot



requires 20 network switches and 1,600 cables. It consumes 91 kilowatts per hour and costs \$3.3 million. HP Moonshot server technology would perform a similar workload with 1,600 servers, but would occupy one-half of a rack, require two switches and 41 cables, consume 9.9 kilowatts and cost \$1.2 million. That’s 89 percent less energy, 94 percent less space, 63 percent less cost, and 97 percent less complexity.

Mainstream IT workloads would not likely see the same cost and power savings because more processor power would be required to perform a similar workload. Those applications—and compute-intensive applications like scientific and technical computing—will be best served by traditional approaches. In some cases, however, users might trade off cost and power for the space savings achieved in the Moonshot program.

A complete program

This kind of sea change requires more than just great innovation. It requires the industry—including partners and key customers working together to evaluate the technology for various workloads. HP Project Moonshot provides a framework to enable that kind of exploration and collaboration. There are three pillars: the Redstone Development Server Platform, the HP Discovery Lab, and the HP Pathfinder Program.

The Redstone Development Server Platform

The Redstone Development Server Platform is our first platform to incorporate extreme low-energy processors. It uses Calxeda EnergyCore quad-core ARM SOCs. It provides up to 288 servers in a single 4U chassis and implements many of the Moonshot features we described earlier including pooled power, shared cooling, integrated high-performance network fabric, and integrated systems management.



The HP Discovery Lab

Combine access to the Redstone Development Server with access to HP experts and you have the HP Discovery Lab. It is designed to help select customers and partners get started with extreme low-energy computing. Initially accessible on site in Houston, Texas, or remotely worldwide, it is staffed by technology experts from HP and HP Pathfinder partners (see below). Discovery Labs will also be opening in Europe and Asia.

The HP Discovery Lab lets participants investigate, test, and benchmark applications in a secure and confidential environment to determine which computing infrastructure is best suited to their application. The HP Discovery Lab fosters open collaboration with other program participants and partners through a secure social media portal. This is the forum industry leaders will use to develop the best practices, standards, and usage models that will drive extreme low-energy computing over the long haul.

The HP Pathfinder Program

The HP Pathfinder Program is established to jump start the industry ecosystem needed to accelerate the adoption of extreme low-energy server technology. Participants will include industry leaders, ISVs, and compute, storage, and networking partners who are committed to working together to develop and deploy extreme low-energy computing solutions. Initial partners include Intel, Calxeda, ARM, AMD, Canonical, and Red Hat.

Why HP?

We're the largest technology company in the world, but we're about more than technology. We see collaboration among industry partners as the way to bring real solutions to bear on real customer problems. Our innovation and leadership have resulted in some of the most important advances in helping customers meet large-scale computing challenges. They include:

- **Industry standard servers**—Beginning in the mid-1990s, we worked with other leaders to make x86 servers the workhorses of the industry. Since then we have lead the industry in server shipments for 61 straight quarters.
- **Blade systems**—We recognized blade systems as the next critical step in high-density server scale-out and developed the technologies needed to make them serve the most mission-critical applications. We now ship more x86 blade systems than IBM, Dell, and Cisco combined.
- **Modular data centers**—High-density, energy-efficient servers are a good start, but combined with the HP Performance Optimized Data Center 240a—the HP EcoPOD—customers can achieve even greater server density while reducing energy cost by up to 95 percent and deploying entire new data centers 88 percent faster and at a quarter of the cost.

HP Project Moonshot is the beginning of a journey that industry leaders and the new generation of Internet businesses will take together. It will require the best technology combined with innovation, leadership, and collaboration. Our destination—the connected society and economy ahead of us. If that's the destination for your business, too, then learn how you can join us. Visit hp.com/go/moonshot.

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